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OUR TWO BRAINS.

BY RICHARD A. PROCTOR.

(*Continued from p. 523, Vol. VI.*)

THE case of Sergeant F. (a few of the circumstances of which have been already mentioned) seems to correspond with Dr. Wigan's theory, though that theory is far from explaining all the circumstances. The man was wounded by a bullet which fractured his *left* parietal bone, and his *right* arm and leg were almost immediately paralysed. When he recovered consciousness three weeks later the *right* side of the body was completely paralysed, and remained so for a year. These circumstances indicate that the cause of the mischief still existing lay in the shock which the left side of the brain received when the man was wounded. The right side may have learned, as it were, to exercise the functions formerly belonging to the left side, and thus the paralysis affecting the right side until this had happened may have passed away. These points I have already discussed, however. Others may now be noted with advantage. I would specially note some which render it doubtful whether in the abnormal condition the man's brain acted at all, whether, in fact, his condition, so far as consciousness was concerned, was not similar to that of a frog deprived of its brain in a certain well-known experiment. (This appears to be the opinion to which Professor Huxley inclines, though, with proper scientific caution, he seems disposed to suspend his judgment.) The facts are very singular, whatever the explanation may be.

In the normal condition, the man is what he was before he was wounded—an intelligent, kindly fellow, performing satisfactorily the duties of a hospital attendant. The abnormal state is ushered in by pains in the forehead, as if caused by the constriction of a band of iron. In this state the eyes are open and the pupils dilated. (The reader will remember Charles Reade's description of David Dodd's eyes, "like those of a seal.") The eyeballs work incessantly, and the jaws maintain a chewing motion. If the man is *en pays de connaissance*, he walks about as usual; but in a new place, or if obstacles are set in his way, he stumbles, feels about with his hands, and so finds his way. He offers no resistance to any forces which may act upon him, and shows no signs of pain if pins are thrust into his body by kindly experimenters. No noise affects him. He eats and drinks apparently without tasting or smelling his food, accepting assafœtida or vinegar as readily as the finest claret. He is sensible to light only under certain conditions. But the sense of touch is strangely exalted (in all respects apparently, except as to sensations of pain or pleasure), taking, in fact, the place of all the other senses. I say the sense of touch, but it is not clear whether there is any real sensation at all. The man appears in the abnormal condition to be a mere machine. This is strikingly exemplified in the following case, which I translate directly from Dr. Mesnet's account:—"He was walking in the garden under a group of trees, and his stick, which he had dropped a few minutes before, was placed in his hands. He feels it, moves his hand several times along the bent handle of the stick, becomes watchful, seems to listen, suddenly he calls out, "Henry!" then, "There they are! there are at least a score of them! join us two, we shall manage it." And then putting his hand behind his back as if to take a cartridge, he goes through the movement of loading his weapon, lays himself flat on the grass, his head concealed by a tree, in the posture of a sharpshooter, and with shouldered weapon follows all the movements of the enemy whom he fancies he sees at a short distance." This, however, is an assumption: the man cannot in this state *fancy* he sees, unless he has at least a recollection of the sensation of sight, and this would imply cerebral activity. Huxley, more cautious, says justly that the question arises "whether the series of actions constituting this singular pantomime was accompanied by the ordinary states of consciousness or not? Did the man dream that he was skirmishing? or was he in the condition of one of Vaucanson's automata—a mechanism worked by molecular changes in his nervous system? The analogy of the frog shows that the latter assumption is perfectly justifiable."

The pantomimic actions just related corresponded to what probably happened a few moments before the man was wounded; but this human automaton (so to call him, without theorising as to his actual condition) goes through other performances. He has a good voice, and was at one time a singer in a *café*. "In one of his abnormal states he was observed to begin humming a tune. He then went to his room, dressed himself carefully, and took up some parts of a periodical novel which lay on his bed, as if he were trying to find something. Dr. Mesnet, suspecting that he was seeking his music, made up one of these into a roll, and put it into his hand. He appeared satisfied, took up his cane, and went downstairs to the door. Here Dr. Mesnet turned him round, and he walked quite contentedly in the opposite direction, towards the room of the *concièrge*. The light of the sun shining through a window now happened to fall upon him, and seemed to suggest the footlights of the stage on which he was accustomed to make his appearance. He stopped, opened his roll of imaginary music, put himself into the attitude of a singer, and sung, with perfect execution, three songs, one after the other. After which he wiped his face with his handkerchief, and drank, without a grimace, a tumbler of strong vinegar and water which was put into his hand."

But the most remarkable part of the whole story is that which follows. "Sitting at a table in one of his abnormal states, Sergeant F. took up a pen, felt for paper and ink, and began to write a letter to his general, in which he recommended himself for a medal on account of his good conduct and courage." (Rather a strange thing, by the way, for a mere automaton to do.) "It occurred to Dr. Mesnet to ascertain experimentally how far vision was concerned in this act of writing. He therefore interposed a

screen between the man's eyes and his hands; under these circumstances, F. went on writing for a short time, but the words became illegible, and he finally stopped, without manifesting any discontent. On the withdrawal of the screen, he began to write again where he had left off. The substitution of water for ink in the inkstand had a similar result. He stopped, looked at his pen, wiped it on his coat, dipped it in the water, and began again with a similar result. On another occasion, he began to write upon the topmost of ten superimposed sheets of paper. After he had written a line or two, this sheet was suddenly drawn away. There was a slight expression of surprise, but he continued his letter on the second sheet exactly as if it had been the first. This operation was repeated five times, so that the fifth sheet contained nothing but the writer's signature at the bottom of the page. Nevertheless, when the signature was finished, his eyes turned to the top of the blank sheet, and he went through the form of reading what he had written—a movement of the lips accompanying each word; moreover, with his pen, he put in such corrections as were needed, in that part of the blank page which corresponded with the position of the words which required correction in the sheets which had been taken away. If the five sheets had been transparent, therefore, they would, when superposed, have formed a properly-written and corrected letter. Immediately after he had written his letter, F. got up, walked down to the garden, made himself a cigarette, lighted and smoked it. He was about to prepare another, but sought in vain for his tobacco-pouch, which had been purposely taken away. The pouch was now thrust before his eyes and put under his nose, but he neither saw nor smelt it; when, however, it was placed in his hand, he at once seized it, made a fresh cigarette, and ignited a match to light the latter. The match was blown out, and another lighted match placed close before his eyes, but he made no attempt to take it; and if his cigarette was lighted for him, he made no attempt to smoke. All this time his eyes were vacant, and neither winked nor exhibited any contraction of the pupil."

These and other similar experiments are explained by Dr. Mesnet (and Professor Huxley appears to agree with him) by the theory that F. "sees some things and not others; that the sense of sight is accessible to all things which are brought into relation with him by the sense of touch; and, on the contrary, insensible to all things which lie outside this relation." It seems to me that the evidence scarcely supports this conclusion. In every case where F. appears to see, it is quite possible that in reality he is guided entirely by the sense of touch. All the circumstances accord much better with this explanation than with the theory that the sense of sight was in any way affected. Thus the sunlight shining through the window must have affected the sense of touch, and in a manner similar to what F. had experienced when before the foot-lights of the stage, where he was accustomed to appear as a singer. In this respect there was a much closer resemblance between the effect from sunlight and that of the light from footlights, than in the circumstances under which both sources of light affect the sense of sight. For in one case the light came from above, in the other from below; the heat would in neither case be sensibly localised. Again, when a screen was interposed between his eyes and the paper on which he was writing, he probably became conscious of its presence in the same way that a blind man is conscious of the presence of objects near him, even (in some cases) of objects quite remote, by some subtle effects discernible by the sense of touch excited to abnormal relative activity in the absence of impressions derived from the sense of sight. It is true that one might have expected him to continue writing legibly, notwithstanding the interposed screen; but the consciousness of the existence of what in his normal condition would effectually have prevented his writing legibly, would be sufficient to explain his failure. If, while in full possession of all our senses, the expectation of failure quite commonly causes failure, how much more likely would this be to happen to a man in F.'s unfortunate abnormal condition? The sense of touch again would suffice to indicate the presence of water instead of ink in his pen when he was writing. I question whether the difference might not be recognised by any person of sensitive touch after a little practice; but certainly a blind man, whose sense of touch was abnormally developed, would recognise the difference, as we know from experiments which have indicated even greater delicacy of perception than would be required for this purpose. The experiment with superposed sheets of paper is more remarkable than any of the others, but certainly does not suggest that light makes any impression upon Sergeant F. It proves, in fact, so far as any experiment could prove such a point, that the sense of touch alone regulates the man's movements. Unconscious of any change (because, after the momentary surprise produced by the withdrawal of the paper, he still found he had paper to write on), he continued writing. He certainly did not in this case, as Dr. Mesnet suggests, see all things which are brought into relation with him by the sense of touch; for if he had he would not have continued to write when he found the words already written no longer discernible.

On the whole, it appears reasonable to conclude, as Professor Huxley does, that though F. may be conscious in his abnormal state, he may also be a mere automaton for the time being. The only circumstance which seems to oppose itself very markedly to the latter view is the letter-writing. Everything else that this man did was what he had already done prior to the accident. If it could be shown that the letters written in his abnormal state were transcripts, not merely *verbatim et literatim*, but exact in every point, of some which he had written before he was wounded, then a strong case would be made out for the automaton theory. Certainly, few instances have come under the experience of scientific men where a human being has so closely resembled a mere machine as this man appears to do in his abnormal condition.

The moral nature of F. in his abnormal condition is for this reason a matter of less interest than it would be, did he show more of the semblance of conscious humanity. Still it is worthy of notice, that, whereas in his normal condition he is a perfectly honest man, in his abnormal state "he is an inveterate thief, stealing and hiding away whatever he can lay hands on with much dexterity, and with an absolutely absurd indifference as to whether the property is his own or not."

(*To be continued.*)

RAMBLES WITH A HAMMER.

OVER CHARNWOOD FOREST.

By W. Jerome Harrison, F.G.S.

(*Continued from page* 518, *Vol. VI.*)

THE thickness of the stratified (slaty) rocks of Charnwood may be estimated at about 8,000 ft. The following order of succession of the beds has been made out (Fig. 2).

1. *The Blackbrook Series.* — Fine-grained, pale red

quartzose slates, and whitish slates and grits. These occur at the northern end of the Forest, between Charley and Blackbrook. At Whittle Hill, too, the flinty slate which is worked for hones (and these "Charley Forest" oil-stones are to be found in joiners' shops all over Britain) is probably of the same age.

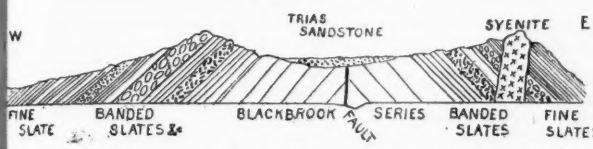


Fig. 2.—Section across Charnwood Forest (diagrammatic).

2. Banded Slates, with volcanic breccias and (in the north-west) immense agglomerates. In the upper part of this division are pebble-beds and grits: a bed of quartz-grit forms the top. The banded slates are very characteristic; they consist of alternate layers of fine and of coarse sediment, the finer layers weathering white. By the difference in colour and texture of the bands it is easy to ascertain the dip or slant of the strata. Such beds are finely shown along the eastern side of Charnwood, at Nanpantan Hill, near Loughborough, the Hanging Rocks of Woodhouse Eaves, and further south round Roecliff Hall, Holgate Hill, and Old John Hill. On the western side they are not so common, though there is a typical exposure at Billabarrow Hill. The quartz grit-bed which lies at the top of this division is shown in the Stable Quarry in Bradgate Park, near the boat-house of Groby Pool, and in a little quarry at Steward's Hay Spring. But the most remarkable beds are the wonderful volcanic agglomerates which lie between Bardon Hill and the Monastery. This north-west corner of Charnwood seems to have been the site of the volcanic cones from which the ashes were ejected which form so large a portion of the Forest Rocks, and here, accordingly, the ejected blocks are largest and most frequent. Great piles of volcanic bombs lie heaped together, marking, perhaps, the proximity of the "necks" up which the fluid materials rose; such collections of blocks are termed agglomerates.

Bardon Hill is an outlying mass, separated from the surrounding strata by lines of fault, of the same beds of volcanic ash which form Green Hill and Peldar Tor. There is a peculiar bed of ash which occurs at all these points and renders their identification possible. It contains numerous crystals (sometimes broken) of felspar, and rounded grains of quartz which stand out like peas on the weathered surfaces of the rock. I have found the same stratum in Birchwood Plantation. The crystals were not formed *in situ*, but were showered out, with all the other matter, from old cones and craters.

3. The highest beds of Charnwood occupy—as is frequently the case—the lowest elevations. They are fine-grained greenish-blue and purple slates, which are largely quarried at Groby on the south, and at Swithland on the south-east. Underneath newer rocks they doubtless extend for a considerable distance; but they are only brought up again at one spot, viz, to form a knoll in Brazil Wood, which lies half-way between Swithland and Mountsorrel. Here Mr. Allport and myself were fortunate enough to discover the junction with the granite. The latter rock has pushed its way through the slate, sending long tongues into it and altering it into a micaceous schist, which is crowded with garnets.

A little study in the field of the three sets of strata we have now described will show that they are usually inclined at rather high angles—thirty to sixty degrees—to the horizon. All along the eastern side of the forest the various beds dip steadily to the east. But as we approach the southern end the direction of the slant changes—in Bradgate Park—to south-east and south, and ultimately it sweeps right round to the west, in which direction the strata are inclined all along the western side, from Markfield to the Monastery, and beyond. From this opposing dip of the rocks on the opposite sides of Charnwood, it is clear that there must be a point, somewhere between, where the dip changes; such a point is called an *anticlinal*, and the anticlinal line separating the strata which dip east from those which dip west can be traced running from north-west to south-east, right from White Horse Wood, by Lubcloud and Bawdon Castle, down Ling Dale to Holgate Lodge. This anticlinal line runs along a valley, and not, as some might expect, along a ridge. The fact is that along such an axis the beds are weakened by the strain, and they crack and fissure; the agencies of denudation avail themselves of the opportunity, and soon the rocks along the "anticline" are eroded and a valley is formed (Fig. 2).

Subsequent earth-movements have, in the case of Charnwood, converted the anticlinal line into a line of fault also. The beds have been there cracked, and the strata on the eastern side have slipped down at least 500 ft. Yet no precipice of 500 ft. altitude divides the eastern half of the Forest from the western. For again the levelling agencies of rain and frost and ice have acted most on the most elevated portion (the western half), and reduced the whole to tolerable evenness. It is most interesting to find, as the geological surveyors have recently done in the "rainless" tracts of the western part of the United States, faults really marked by terraces many miles in length; but here, in England, the geologst gets no such indications of "growing faults."

In seeking for the conditions under which the stratified rocks of Charnwood were deposited, we must study modern volcanic districts, and in the Phlegræan fields, west of Naples, we have a scene probably not much unlike that presented by Charnwood many millions of years ago. Here numerous small cones have ejected enormous quantities of scoriæ, lapilli, and dust, which form a well-stratified deposit of considerable thickness, covering many square miles. Such was probably the state of the Charnwood area in Pre-Cambrian times. The eruptions took place chiefly in the north-western corner, near Whitwick, where several craters must have discharged steam and ashes. "The lowness of the hills and porosity of their materials would be unfavourable to rivers; the ash would settle down in the quiet waters of lakes or lagoons, little rolled, or be spread out upon the plain." As to the absence of fossils, we know that the organic nature of the only supposed Pre-Cambrian fossil—the famous *Eozoon*—is now strongly questioned, so that their absence in the Pre-Cambrian slates of Charnwood need not surprise us; but, in addition, it is plain that the continual showers of hot ashes from the volcanoes then in action here would be inimical to life, whether on the neighbouring land or in the waters.

(To be continued.)

THERE lies before us a record of the splendid services rendered, and the gallant rescues effected, by the boats of the Royal National Lifeboat Institution during the year which has just closed. From it we gather that 780 lives have been saved through the instrumentality of the Society during the past twelve months, and 31,343 since its foundation. In order to carry on this great work, which is second to none in importance, and to maintain in efficiency their fleet of 284 boats, the committee make a strong appeal to the public for help, feeling assured that that appeal will not be made in vain. Contributions are received by all the London and Country Bankers, and by the Secretary, Charles Dibdin, Esq., 14, John-street, Adelphi, W.

XUM

THE EARTH'S SHAPE AND MOTIONS.

By Richard A. Proctor.

(*Continued from p. 502, Vol. VI.*)

IN nearly all works on astronomy, the Ptolemaic system of the universe is described and illustrated. Judged by the ordinary illustrations, it seems sufficiently simple. We find the earth in the centre, and a number of concentric circles, representing the paths of the sun, moon, and planets; so that the system appears even simpler than the Copernican, in which the sun is the centre of the planetary motions, while the earth is the centre of the moon's motion.

But in reality there is no such simplicity in the Ptolemaic system. It need hardly be said that, if the planets really circled around the earth, they would appear to describe circular paths round the heavens, and not the looped or convoluted paths which they are actually seen to traverse.

What Ptolemy really asserted about the planets was different, however. He by no means argued, in the face of the most obvious evidence, that the concentric circular paths seen in his system are the actual paths of the planets. These circles are the paths traversed by imaginary points round which the planet itself travels in a smaller circle. It is clear that by this conception the looped path of a planet is, to a certain extent, explained.

Suppose, for instance, that A B represents part of the path of a moving point, round which a planet is travelling in a circle such as 1, 2, 3, 4, the centre of the *point's* path being the earth at E. Then it is perfectly obvious that, if the planet travel more quickly in its circle 1, 2, 3, 4, than the point travels along A B, it will appear, when at 1, to travel backwards. When at 2, it will be travelling *on its own path* directly away from E; but, as the centre of its motion is continually advancing, it will itself appear to advance at the same rate. At some point between 1 and 2 the backward motion must have changed into forward motion, and this point therefore was one of the planet's *stationary points*. At 3, the planet is not only advancing with the moving centre, but with its own more rapid motion round C. Here, then, it seems to advance most rapidly. At 4 it is still advancing, though its own motion is now in such a direction as not to add to its apparent motion. Then between 4 and 3 comes a stationary point, as between 3 and 2, after which the planet seems to travel, for a short time, backwards. Next it reaches another stationary point, then advances, and so on continually.

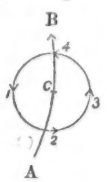


Fig. 1.

And, without entering into the special relations presented by the different planets, we can see at once that, according to the principles of the Ptolemaic system, the advances, stations, and retrogressions of the planets can, *in a general way*, be fairly accounted for. Further, by giving a suitable inclination to the plane of the smaller circle 1 2 3 4, the looped figures of the planets' apparent paths and the various shapes of the loops can be explained: still, however, only in a general way.

It is clear, however, to begin with, that this system, which requires an imaginary as well as a real centre of motion for each planet, is far from commending itself by the *simplicity* of its character. If we consider it a little farther, and try to conceive the actual path travelled by a single planet, we recognise yet more distinctly the difficulties it presents. But to these considerations we must add the fact, that even in Ptolemy's time it did not account for more than the general features of the planetary motions, while, since his day, a number of irregularities have been detected, of which each would enforce a new form of complication, either in the addition of third, fourth, or fifth smaller circles, or in the displacement of the centres of motion, or in oscillatory motions of the planes in which the planets are supposed to move. It is at once seen, then, that the Ptolemaic system, accepted at first on account of its apparent simplicity, is one of the most complicated and unnatural explanations of observed peculiarities that could by any possibility have been devised.

Passing over the Egyptian system, as simply the Ptolemaic deprived of its essential unity of character, we come to the Copernican, in which the sun is the centre of the planetary motions, the earth being only a member of the planetary scheme.

The Copernican, like the Ptolemaic system, is illustrated in every respectable treatise on astronomy, although, in every instance which has yet come under my notice, such illustrations are very badly executed, insomuch that they pain the souls of those who know anything of the real proportions of the planetary scheme. I therefore refer the reader here to the pictures of the planetary paths which appeared on pp. 310 and 311 of Vol. V. of Knowledge. I have to show how it accounts for the loops in the planetary paths.

Suppose E *e*′ E′ *e* (Fig. 2) the earth's path round the sun at S; P′ P P″ the path of a planet outside the earth; and, further, that the earth travels faster than the planet. Then we might determine all the circumstances of the planet's apparent motion by taking the earth and planet round S, according to their respective rates of motion. But it will be convenient to consider, instead, the varying effects according to the relative situations of the earth and planet. The reader will see at once that the following proof, while much simpler, is not a whit less complete than that obtained by following the motions of both bodies. As I have always found the corresponding explanation given in books on astronomy very little satisfactory to beginners, I have thought it necessary to adopt this simpler one:—

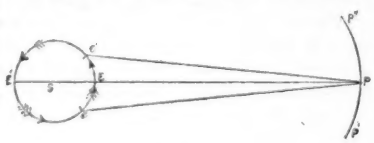


Fig. 2.

Consider first the case where the earth is as at E, the planet as at P, S E P being a straight line. Since the earth is moving faster away from this line than the planet is, it is clear the planet, as seen from the earth, must appear to lag behind, as though moving towards P′; suppose the earth as at E′, the planet as at P′; then, as the earth and planet are moving in opposite directions from the line E′ S P, it is obvious that the planet will seem carried forward, or as though moving towards P″, with the sum of the effects due to its own and to the earth's motion respectively. Hence, at some intermediate positions (placed, it is clear, somewhat as *e* and *e*′) the planet situated as at P would seem to be at rest.

Now, both bodies moving at the rates supposed, it is obvious that their relative situations will change through all the arrangements just considered, as the earth, by her more rapid motion, comes again and again into conjunction with the advancing planet (*i.e.*, to a position such as that first considered in the preceding paragraph). Hence, obviously, we have, starting from conjunction, the following successive characteristics of the planet's motion:—

A relatively slow retrogression, gradually diminishing till the planet seems momentarily at rest, then advance, gradually increasing, till it attains its maximum, when it is much more rapid than the former retrogradation; thence

diminution in the rate of advance until the planet again seems momentarily at rest; and, finally, a gradually increasing retrogradation up to that observed at first. And, obviously, the duration of the advancing motion is considerably greater than that of the retrogradation, precisely as the arc *e* E *e'* is greater than the arc *e'* E' *e*. Clearly, it only requires that the path of the planet should not be in the same plane as the earth's for this alternation of advance and recession to produce an apparently looped path; while, according to the position of the planet with respect to the points in which its path intersects the plane of the earth's path, the shape of the loops will vary through all the forms described earlier in the chapter.

Again, it is clear that, so far as planets external to the earth are concerned, the relation of the loops in size and number can be at once accounted for. Planets very far from the earth would obviously exhibit a relatively small loop, and many loops in their complete circuit of the heavens. On the other hand, planets not so far from the earth would exhibit larger loops and fewer in the circuit, or even but one loop in more than one circuit.

As for planets within the orbit of the earth, a very simple device will at once exhibit their relations without any new discussion. To an interior planet, the earth is, of course, an exterior planet, and therefore she describes in appearance just such loops as exterior planets have been shown to describe. But, if one conceives an indefinitely long line passing always through the centres of the earth and an interior planet, it is obvious that, whatever path one end of the line describes on the heavens as earth and planet travel on their orbits, a similar path will the other end describe on the opposite region of the heavens. In other words, an interior planet describes an apparent path precisely similar to that which the earth, as seen from that planet, would appear to describe, or, as already shown, a series of loops resembling those described by an exterior planet.

Copernicus was not able to account for all the peculiarities of planetary motion. In fact, when once he considered minor peculiarities, he found precisely the same difficulties which had perplexed the Ptolemaists. He had got rid of the grand difficulty of the Ptolemaic theory—the conception of a set of moving *points* around which, instead of around real centres, the planets were required to move. But all the minor difficulties yet remained. It was Kepler's task to remove them.

The task was a hopeful one, however, since there was no longer an ill-conditioned hypothesis as the basis of the whole system of astronomy. It is shown in every book of astronomy how Kepler mastered all the minor difficulties by detecting the simple laws that (1), the planets move in ellipses round the sun, which lies in a focus of each path, and (2), the line drawn from the sun to a planet passes over equal areas in equal times.

I must not, however, altogether neglect the system suggested by Tycho Brahé, according to which the earth was replaced at the centre of the universe, the sun circling round it, but, being himself the centre of all the planetary motions, Tycho was unfortunate in coming after Copernicus. Had he lived a few centuries earlier, his theory would most probably have found acceptance, and, had it once been established, Copernicus would have found it very difficult to establish his own views. I have no hesitation in pronouncing the Tychonic system a masterpiece of ingenuity. It accounts quite as well as the Copernican for all the celestial motions known in Tycho's day. It required no modification other than one resembling that by which Kepler improved the Copernican theory, to account for observed motions as exactly as on the Keplerian theory. For the effects observed, if the sun travelled in an ellipse round the earth, and the planets, in their proper ellipses, round the sun, would be exactly the same as those observed if the sun were the centre of all the motions, the earth travelling in its proper ellipse about him. And there was this further point in favour of the Tychonic system—that it got rid of the great difficulty (pointed out by Brahé himself) that if the earth circled in an enormous orbit round the sun, the stars ought to be seen to shift in position unless their distances were inconceivably great.

So that, as a matter of fact, the Copernican theory had nothing in its favour but the great superiority in the sun's volume which was suspected even in Tycho Brahé's day. So far as this superiority rendered it likely that the sun and not the earth, was the centre of the universe, the theory of Copernicus seemed the better. So far as the point considered in the last sentence of the preceding paragraph was concerned, the theory of Tycho Brahé seemed the better. Kepler, by changing the circles of Copernicus into ellipses, did not alter the relative position of the two theories, since his ellipses were quite as available for the Tychonic system as for the Copernican.

It was only when Newton established the theory of gravitation that the Copernico-Keplerian theories which had been already adopted could be said to have been demonstrated. Into the proof of universal gravitation it would be out of place to enter here. Suffice it to say that the proof was made complete even by Newton himself, though since his days a thousand new evidences have been revealed which have placed the theory absolutely beyond question, save by those too ignorant to understand the matter. It will be seen at once how it affects the question which had been at issue between Tycho and the Copernicans. Obviously if the sun is the centre of the planetary motions, he, and not the earth, is the overruling attractive body; the earth, then, must travel around him, and not he around the earth.

But although Newton, in establishing the law of gravity, had established the Copernican system, the most striking proof of that system was that obtained when Bradley discovered and explained the aberration of light.

(To be continued.)

DINOSAURS.*

THE first naturalists who described reptiles as crawling animals would certainly have modified the opinion that they expressed had they known the strange creatures whose history we are about to sketch.

These animals, which are designated as ornithoscelians or dinosaurians, partake, by certain characteristics of their organisation, of the nature of mammals, birds, and reptiles properly so called, while at the same time exhibiting characters that are proper to themselves. They seem to bridge over the gap which in present nature separates the most perfect of the reptiles, the crocodiles and the tortoises, from the lower mammals—the marsupials—and from such birds as the ostrich, emu, and cassowary. They are so far removed from the reptiles that we have to form a distinct subclass for them equal in value to that which is admitted for reptiles of the present time.

The differences that they present from our reptiles are much greater than those that we find between tortoises and serpents, for example, to merely cite the two extreme terms of the series. We know nothing of the dinosaurs except their skeleton. It is probable that if it were permitted us

* *Science et Nature.*

to know what their organisation was, how their circulation was effected, and what their mode of development was, we should not hesitate to put them into a class intermediate between that of the mammals and birds and that of the reptiles properly so-called. It was toward 1820 that Gideon Mantell found the first bones of dinosaurians in the midst of Tilgate forest, Isle of Wight, in strata which are referred to the lower portion of the Cretaceous formation, and which are terrestrial and fresh-water ones that mark a transition from the Jurassic to the Cretaceous. These bones, which were very incomplete, were referred by Mantell to an animal of great size, which he called an *iguanodon*, as the teeth offered certain analogies, as regards form, with those of a lizard of the present time called the iguana. Since that epoch, and especially since a few years back, our knowledge concerning the dinosaurs has peculiarly increased, and we are beginning to get a glimpse, among these animals, of very different types, which indicate orders just as distinct as are those of the pachyderms, ruminants, and carnivora among mammals.

Upon the sides of the Rocky Mountains, in the United States, we find strata which can be followed for several hundred miles in extent, and which have yielded for the investigation of paleontologists a small marsupial, remains of fishes, remains of pterodactyls, crocodiles, and tortoises, and especially an enormous quantity of bones of gigantic dinosaurs. We have here a true bone-yard in which lie buried, pellmell, the most curious and strange forms of all the animals that the ancient ages have bequeathed to us. It is to the admirable researches of Marsh and Cope that we owe our knowledge of a fauna that has entirely disappeared. Guided by the two great laws of correlation of forms and subordination of characters—laws which we owe to the incomparable genius of Cuvier, and which, like Ariadne's thread, permit us to find our way in the inextricable labyrinth that is presented by the forms of extinct animals—these two learned American paleontologists have evoked an entirely new world, and brought up before us the evidences of a fauna of which nothing in existing nature could have given us the least notion.

During the secondary epoch the dinosaurs lived also in Europe and in Southern Africa, where they were represented by very diverse types, as has been shown us by the learned researches of Mantell, Owen, Phillips, Huxley, Seeley, Hulke, Dollo, and Matheron.

Very recent researches have thrown an entirely new light upon the organisation of these animals, and permitted of as complete a study of their skeletons as could have been made of those of animals now living. We can grasp the general features that connect them with other reptiles, and the peculiar ones that distinguish them from each other.

What essentially separates the dinosaurs from all other reptiles is that the sacrum is always composed of more than two vertebræ, which form a very solid single bone, like that of mammals. These vertebræ, which exceed the normal number of two, are caudal ones that are modified so as to serve as a support of the pelvis, which is considerably enlarged, in order to be able to support the usually robust hind limbs. To judge by the great width presented by the medullary canal, the spinal marrow must have been much swollen in the sacral region, and have furnished very large nerves to a limb that was strongly developed and moved by extremely powerful muscles.

The ribs are highly developed, and their size shows that the thoracic region was very ample, and that consequently the lungs must have been large.

As the food of the dinosaurs was very varied, the form of their teeth is, as may be seen, entirely different according to the types examined. The flesh-eaters, such as the megalosaurus (Fig. 1), had strong, cutting teeth, which were crenulate at the edges. The maxillaries, as well as the intermaxillaries, were armed with such teeth, and these must

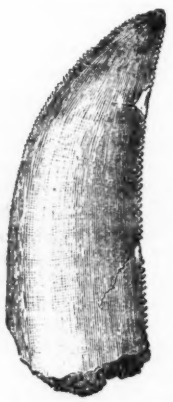


Fig. 1.—Tooth of Megalosaurus.

Fig. 2.—Tooth of Iguanodon.

have been formidable. The herbivora, such as the iguanodon (Fig. 2), the vectisaurus, the laosaurus, and the hypsilophodon, had maxillaries that were provided with teeth admirably arranged for cutting and grinding. These teeth became worn out, like those of existing herbivorous mammals, and were indefinitely replaced, that is to say, as soon as one of them was worn out, another one succeeded it. What is not found in existing reptiles was a motion of the jaws, as in the ruminants of our epoch, in order to allow the teeth to grind food. The size of the apertures and channels through which the nerves passed shows that there existed soft lips and cheeks, without which the mastication of food would have been entirely impossible.

The hadrosauri, which were herbivora, had their teeth arranged in several rows that formed, through wear, a grinding surface in the form of a checker-board. In the herbivora which have been grouped under the name of ornithopodia the intermaxillaries were not provided with teeth, and the same was the case with the extremity of the lower jaw, which was very likely armed during life with a horny beak; by means of which the animal cut off the buds and leaves that constituted its food.

Many dinosaurs had naked skin. In others, that are designated as stegosauri, the body was protected by bony shields and by spines.

We are acquainted with dinosaurs of all sizes, from the gigantic atlantosaurus of the Rocky Mountains, which attained a length of at least 80 feet, down to the nanosaurus, which was scarcely as large as a cat.

The secondary epoch, in which the dinosaurs lived, has justly been entitled the reign of reptiles. It was then that this group reached its maximum development. The mammals were very puny during this epoch, and were represented solely by the most inferior kinds. The dinosaurs seem to have then played upon the surface of the globe the role that the large carnivora and herbivora do now; but, while mammals have always gone on improving until they already offered at the end of the Tertiary epoch the magnificent development which we now see, reptiles have gone on continuously diminishing in importance. The higher animals have gradually excelled beings of a less perfect organisation.

Dating from the Triassic epoch, the dinosaurs were already represented by so diverse types that it seems as if these were the descendants of animals that existed at a

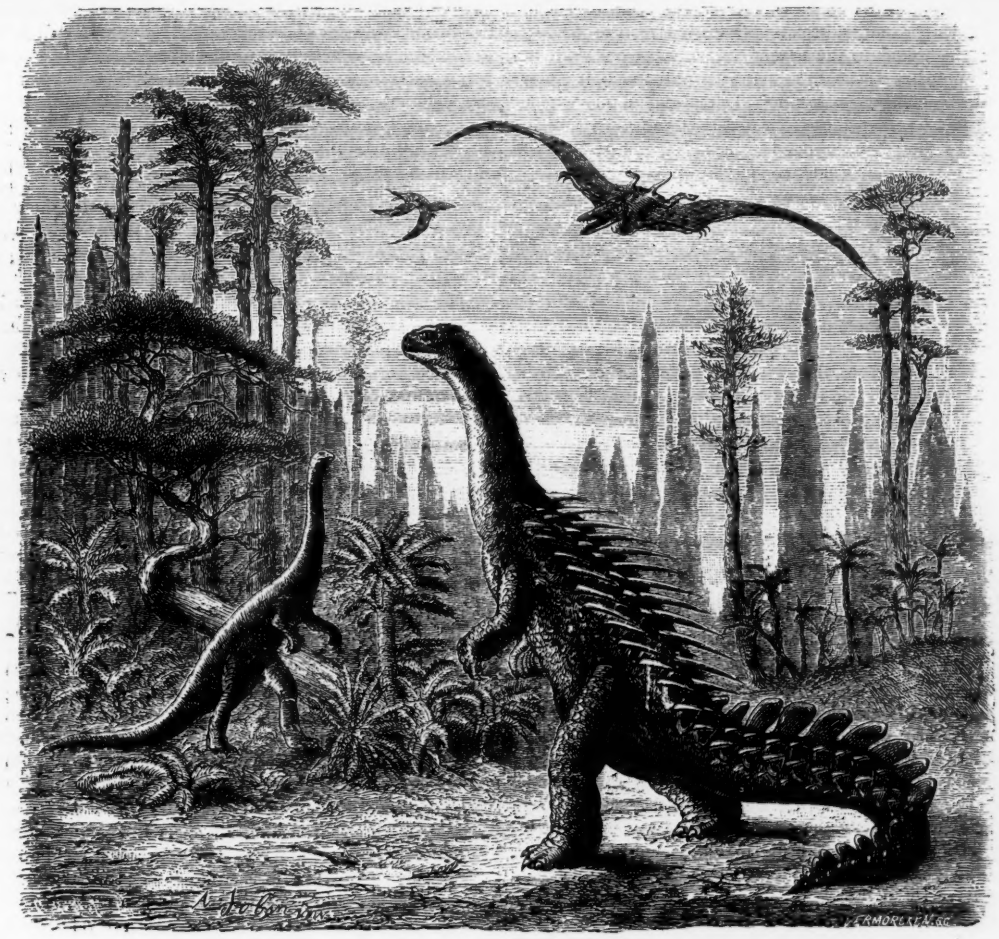


Fig. 3.—American Landscape of the Jurassic Epoch, with reptiles and plants of the period.

more remote epoch. It was at the end of the secondary epoch that these animals disappeared for ever without leaving any descendants. They were unable to adapt themselves to the new conditions of existence that were imposed upon them, and they died, whilst the mammals, on the contrary, daily proceeded more towards the highest types.

The temperature was high during the Jurassic epoch, and uniform throughout the earth, as demonstrated by the existence in the north of Europe of corals comparable with those of the Gulf of Mexico or the South Sea. During the upper Jurassic epoch our country must have been cut up into lagoons, marshes, and frequently inundated estuaries. These privileged localities had a richer and more varied vegetation than the mountainous portions. Here grew large ferns with leathery fronds, while the declivities and uplands were covered with plants that approached the pandani, araucariæ, and cycads, and having almond-like seeds that formed the food of the herbivorous dinosaurs of the epoch.

If, through the admirable discoveries that have been made in recent years, we endeavour to bring to life again the fauna of the upper Jurassic period in the United States, we shall find one that is no less rich and strange than that of the Old World. Here we have, amid araucariæ and cycads, the gigantic stegosaurus, with a body clothed with bony plates and spines, that formed a powerful armour for it, and with fore legs much shorter than the hind ones; the compsonotus, with fore paws equally as well developed as the hind ones; and the strange flying reptiles, the pterodactyls (Fig. 3).

(To be continued.)

THOUGHT AND LANGUAGE.

By ADA S. BALLIN.

I.

BEFORE the acceptance of the theory of evolution, if a question was raised as to what is the chief point of difference between man and the lower animals, the indignant answer was given—indignant, because any comparison between the two was odious—"Why, man was created in God's image," or "Man alone of all creatures is endowed with a soul," or "Man alone possesses the faculty of reasoning"; and the same replies may still be met with from some few theologians of the old school.

But the theory of evolution has demonstrated the fact that the difference between man and the lower animals is one of degree only. The hypothesis, that all animals below

the rank of man were merely different kinds of self-acting machines having nothing in common with him, has wholly exploded; physiologists having conclusively proved that, in whatever organism there is a nervous system, there also some kind of consciousness exists, the states of consciousness being more varied, more acute, and better organised in proportion as the complexity of the nervous system is greater and its substance more developed.

Starting with the proposition that there is nothing in mind which was not derived from the senses, we find that as we rise in the scale of evolution, and the senses become more specialised and acute, so also the mental states become more complex and more numerous, until we reach the stage of the highest quadrumana.

From these man is not distinguished by any difference in the sense organs, save in that of touch. Many beasts have keener senses of smell and hearing than man, and most birds have far keener sight and better apprehension of locality. It is probable, also, that the lower animals possess certain kinds of knowledge at which man can only guess, and that they have powers of thought which men are too apt to underrate. In fact, men are given to ascribing too much of the intelligence of animals to instinct and too little of human intelligence to the same cause. Instinct is the inherited result of experience, and it influences action so subtly, that in most cases it is impossible to discover where it ends and individual experience comes into play in what we call reasoning.

I can, however, cite a case of reasoning on experience that could hardly have been inherited, of which I was an eye-witness. While I was paying a call the other day, the lady of the house, offering refreshment, went to the sideboard and got out a decanter of sherry and some glasses. On this her little pet dog, a Maltese terrier, became very much excited, and watched her eagerly. When the wine was poured out and handed round, he stood up on his hind legs and begged in turn of all the guests, and, as no one had anything to give him, he began to cry and whine in a most melancholy fashion. I asked the meaning of this extraordinary behaviour, and my friend answered that the dog was always accustomed to see biscuits brought out with the wine. For these he entertained a sincere affection, and the visitors usually gave him little pieces of them. Former experience had led him to make a strong mental association in his mind between wine and biscuits; hence, when the sherry made its appearance, he inferred that the biscuits were not far distant, and in fact it was only by showing him the empty cupboard, and letting him examine our hands and find them guiltless of crumbs, that we could convince his reason that the two were not inseparable by nature. By a similar process of reasoning a baby will associate the idea of its feeding-bottle with that of satisfied appetite, and if by chance it were to suck at the bottle and find nothing forthcoming we may imagine that for the moment its faith in the order of nature would be shaken. We have all to experience some such shocks to our established beliefs in the course of time!

The laws of association by similarity and contiguity are evidently the same for the lower animals as for man; but people are very fond of saying that the lower animals do not generalise. That this is untrue can easily be proved by watching the habits of the more intelligent.

For example, monkeys and parrots are said by careful observers never to attempt to crack bad nuts, and they seem to decide whether or not a nut is good, by its weight. A monkey will serve as a good illustration, and we will examine this phase of mind on strictly logical principles.

Experience, whether inherited as what we call instinct, or of its own getting, or both combined, has brought it to the conclusion that nuts which are of light weight contain no kernel. Jacko picks up a particular nut which is light, and at once, concluding that it has no kernel, throws it away without more ado. Here is abstraction of the fact of lightness, common to certain nuts, connected causatively with the fact of *no kernel*, generalised by application to *all nuts;* and then comes the reasoning that what is true of all must be true of each individual. Let us imagine this creature gifted with the power of speech, and teaching a class of young ones to chop logic. A disciple might ask, "Why, sir, did you throw that nut away?" and the sage would answer, "No light nuts have kernels; this nut is a light nut: therefore this nut has no kernel."

Here, in showing the likeness between the intelligence of the lower animals and that of man, we also touch upon the difference. The monkey may know that all light nuts have no kernels, but it has no means of communicating this knowledge. The lower animals may have certain general notions, but, as far as we know, they are without means of expressing them. They can communicate particular things of knowledge, as, for example, a goat can lead its kid to the water and show it how to drink. General notions, however, are based on similarity, and this no animal except man can express; to take a simple instance, the goat can put before its kid several different kinds of herb, but the kid must discover for itself which are alike and which different, for its parent cannot teach it this.

There is indeed a language* which is shared alike by all animals, that of the feelings—expressed in cries or movements. A cry of terror or of pain expresses the same meaning, comes it from bird, beast, or man. An angry man frowns, and an angry bird ruffles its feathers. A child rubs its face up against one's cheek as a token of affection, and a cat rubs up against its master's leg to express the same sentiment. A dog who is ashamed of himself puts his tail between his legs and slinks away with his head down; we say of a man in a similar condition of mind that "he looked small."

In all animals possessing vocal organs, the voice is used for the expression of love. Thus the bird has his love songs, and their tone and sweetness improves in the spring; beasts have their love calls, and the quality of the male's voice alters at certain times, and the man sings serenades. Music is the natural and legitimate expression of the tender passion, and to the present day I think if anyone had the curiosity to inquire into the matter he would find that, out of every hundred songs published, ninety-nine have matters of the heart for their theme.

The language of the will is also, to a great extent, common property. The dog looks round in the street to see if its puppy is following, and its gestures clearly show that the puppy is intended to follow. A cat slaps her kitten if it departs from the parental idea of the way of right conduct. A man points to the door, and the other one, if he is neither strong nor a fool, quits without delay, while a dog, under similar provocation, would give an angry bark.

We can imagine the primitive man as expressing himself, like other quadrumana, wholly by gesture; but, as civilisation advances, gesture sinks into greater and greater disuse, and gives place to the language of the intellect proper, the language which belongs to man alone, which can express relations between things and feelings—Agreement and Difference. We have in articulate speech not only the medium for expressing thought, but words are, to a very large extent, the medium for thought itself.

* We must disregard the original meaning of the word language = tongue, and understand it to mean a system of signs.

Words to civilised people are the signs of thoughts or ideas, but to the savage they are the signs of things, as it were, the coins that can be easily carried about from place to place and exchanged, instead of bearing the burden of the things themselves. The civilised application has been gradually evolved from the savage usage. Language is, at the same time, the outcome and the condition of civilisation, and its development is at every stage suited to the mental status of the people who use it. Hence, conversely, the mental power of an individual or of a nation can be gauged by the capabilities of the language employed.

CHAPTERS ON MODERN DOMESTIC ECONOMY.

X.— THE FRAMEWORK OF THE DWELLING-HOUSE.

GENERAL PRINCIPLES OF CONSTRUCTION—(*continued*).

IN continuation of our notices of the typical examples which attest to the utility of the earth and ash systems for dealing with house-refuse, we may allude, in the third place, to local large gatherings of protracted duration, such as military camps, &c.; and here we are able once more to quote from the decision of high authority. Dr. Buchanan's remarks upon the question, with respect to the sanitary management of Wimbledon Camp, are worth while transcribing in this place, as illustrative of the case in point. He says:*—"In forming an opinion on this point, I have followed, as being the most trustworthy guide, the judgment of Surgeon-Major Wyatt. This gentleman, the principal medical officer of the camp since 1865, has had large experience, under varied conditions of the circumstances affecting the health of camps, and knows well how to estimate the value of the latrine arrangements used therein. He writes, in reference to the first use of earth-closets at Wimbledon in 1868: 'With the exception of two days, nothing could have been more satisfactory than the working of the earth-closets, although, on account of the unprecedented amount of diarrhœa (of which more immediately), they were in unusual demand.' And with regard to their use in 1869, he says: 'During this meeting a better surveillance of the closets has been insisted on, and they have been used to an enormous extent by the vast concourse of people assembled; but I have heard no complaint of any want of deodorisation. . . . . I can safely venture to affirm that this camp is, of all places, perhaps the most suitable for thoroughly testing the value of this important sanitary invention, which has well borne the ordeal.' Further, Captain Mervin Drake, commanding Royal Engineers at Wimbledon, states: 'I consider the dry-earth closet the best system known for military latrines, when a supply of suitable earth is obtainable. . . . . In 1868, at Wimbledon, a sour smell was perceived, which was found to proceed from the peat earth, the fibrous portions of which had fermented with the great heat. . . . . The vaults of the closets should be lined with brick, in cement, asphalte, or other water-tight lining.' The testimony of those who had experience of the earth-closets at Wimbledon is, indeed, almost unanimously in their favour, and the strongest expressions of satisfaction come from those who best know from actual service how great are the difficulties in safely disposing of the excrement of camps."

Our next type concerns the applicability of the system to villages; and here, again, the medical officer of the Privy Council brings the process to most favourable notice with regard to Halton and Aston Clinton, where the plan had been for three and a half years in operation. He found that the system fully substantiated all its claims to be regarded as of the first sanitary importance, and instances the good value (£3 per ton), received for the excellent agricultural commodity it afforded.

All this time we have spoken in terms concerning the earth and ash systems as though they were synonymous. Strictly speaking, however, they are not so, although they may be regarded as of equivalent value, and in the following way:—Dry earth, of a loamy nature, and finely sifted, may, during the present state of affairs, be procured in abundance in every village or country town, without any very great expenditure or inconvenience; and the product of its admixture with excrement is, if anything, but slightly superior to the analogous use of pure ashes. On the other hand, whilst ashes are but slightly inferior to specially dried and sifted loamy earth, which cannot at present be procured in large towns readily and to any extent within reasonable cost, they (the ashes) constitute a waste product which must be got rid of somehow or another, and especially during the wintry months, when their production is at a maximum, and when they are alone adequate to the demands of each case. Thus the two processes, which are of slightly unequal value when their individual attributes of supply, demand, and utility are taken into account, become almost exactly equivalent in the sum total of their benefits to man. *Est modus in rebus* is an old motto, which finds forcible expression here. A combination of the earth with the ash meets every want of the sanitary inspector and domestic economiser, and we are glad to find that firms of such high standing as Moule & Co., The Sanitary Appliance Company, and the Corporation of Manchester, fully recognise the value of the combination.

This leads us to our ultimate type, viz., the application of the system to towns and large cities; and here the question becomes one of almost national importance and of great interest to the philosophical economist, inasmuch as all the *pros* and *cons* admit of a kind of history of evolution in the rise and progress of a system of rational reform which is destined to become one of the most remarkable triumphs of the coming age. It is now some years since the initial step was taken in the Midlands of England to improve upon the old-fashioned form of cesspools. We have already adverted to the divergent hydraulic method, which proceeded from the same source, and has culminated in the vast network of expensive and inadequate sewers of London. The neighbouring and closely allied outgrowth is still manifest in Birmingham, and is of even more recent development than the last-mentioned system; there we find the "pail system," or the removal of effete matters, pure and simple, without any previous treatment whatsoever. It is very much in advance of cesspools of long duration, but is open to serious objection on the score of even partial inattention on the part of the public servants, whose neglect of duty is mostly occasioned by refractory and ignorant tenants of the anti-vaccination class, which causes it to relapse into the olden obnoxious form. In the suburbs of Birmingham, the houses are provided with vaults for the reception of excrement, &c., which only too often are allowed to run to riot. In the town itself, instances are not wanting to show that the "pail-system" is not rigorously compulsory, as it ought to be, and that the open-pail, frequented by numerous inhabitants, is often a source of foul exhalations and a consequent insalubrious condition of things. Then, too, although this has largely supplanted the water system, the latter, nevertheless, holds a partial sway, and, strange to say, in the more modern establishments and better class of buildings in the city, only to find a corrective in expensive

* Appendix to the 12th Report of the Medical Officer of the Privy Council, September, 1870.

methods for the utilisation of sewage and the prevention of pollution of the waters of the district. Now, although all this is in advance of a purely hydraulic system, like that of London, we can scarcely refrain from expressing the opinion, that several interests of a strangely heterogeneous character must have been at work to produce so mixed a result. To sum up, both the pail-system and the hydraulic-system with its counteracting schemes for the disposal, at any cost, of the resultant sewage, are of modern date, and both are failures which differ but in degree.

One step further, and we come to Manchester, the emblem of future perfection. The corporation of the town have taken a most active and praiseworthy precedent in the institution of a system, which, if it were but universally introduced throughout England, would be worthy of the genius of a modern Napoleon. The disposal of house and street refuse of all kinds has been placed under the supervision of a competent staff of workers, and a fair representation of their indefatigable labours was placed before the judges at the late "Health" Exhibition. It was there shown that all the deleterious waste matters for the year 1884 amounted to more than 82,000 tons, which were satisfactorily dealt with at the Health Committee's Works at Holt Town, Beswick, on the North-east side of Manchester. "Of the 82,000 tons sent to Holt Town,* the rags, paper, wire, and tins (110 tons) are sold. The wet and dry cinders are mainly used as fuel for the furnaces of the boilers which work the machinery, effect the evaporation, &c., whilst the remaining matters are converted into manure, soap, candles, lubricating grease, mortar bricks and concrete. . . . . The animal matters have their ammonia fixed by acids or sulphatic salts, and are evaporated to dryness for manure. . . . The sanitary result of the operations of the Health Committee is this, that the death-rate of the city has been reduced from 33 per 1,000 to about 24 or 25 per 1,000. In comparison with many other towns this does not seem a low death-rate; but in comparison with its own former death-rate, it is so, though it will, no doubt, be much further reduced; but Manchester is unlike almost all other towns or cities in being a city of cottages, occupied by 340,000 people of the working-class and the residuum below them. Of the four classes to be found in Manchester during the day, the first, and nearly all the second, live outside the city; the third and fourth are almost the sole residents; and amongst these the death-rate is always high, wherever they may be found."

The Corporation manure manufactured at Holt Town, in consideration of its great intrinsic worth, is valued at the low rate of £3 per ton, a sum of money which is also realisable through the working of the systems of less magnitude which we have already noted, and which come within the range of operation of every intelligent house-owner. So confident of the high commercial value of their product are the Manchester Health Committee, that they invite purchasers to have a special analysis made of each lot they desire to buy, and, moreover, to pay for one half of the cost of such examination; providing, at the same time, a compost whose ingredients shall show an average of the following high standard from an agricultural view-point:

†Organic matter, containing salts of ammonia	35·54
Sulphate of lime	5·76
‡Phosphoric acid	2·36
Alkaline salts, containing 25 per cent. potash.....	4·39
Oxide of iron, alumina, &c.	14·67
Moisture.....	15·07
Insoluble matter	19·41

* Prospectus of the Manchester Corporation Concentrated Manure, 1884, p. 1, *et seq.*

† Containing nitrogen 2·23, equal to ammonia 2·73.

‡ Equal to Tribasic phosphate 5·16.

All that we can say in conclusion is, that we trust that the spirit of exemplary enterprise, attested to by the foregoing facts, will, ere long, be followed practically by every town, village, and isolated tenement throughout the length and breadth of the country, with the happy result in a participation of the benefits which Manchester's inhabitants now so deservedly enjoy.

FIRST STAR LESSONS.

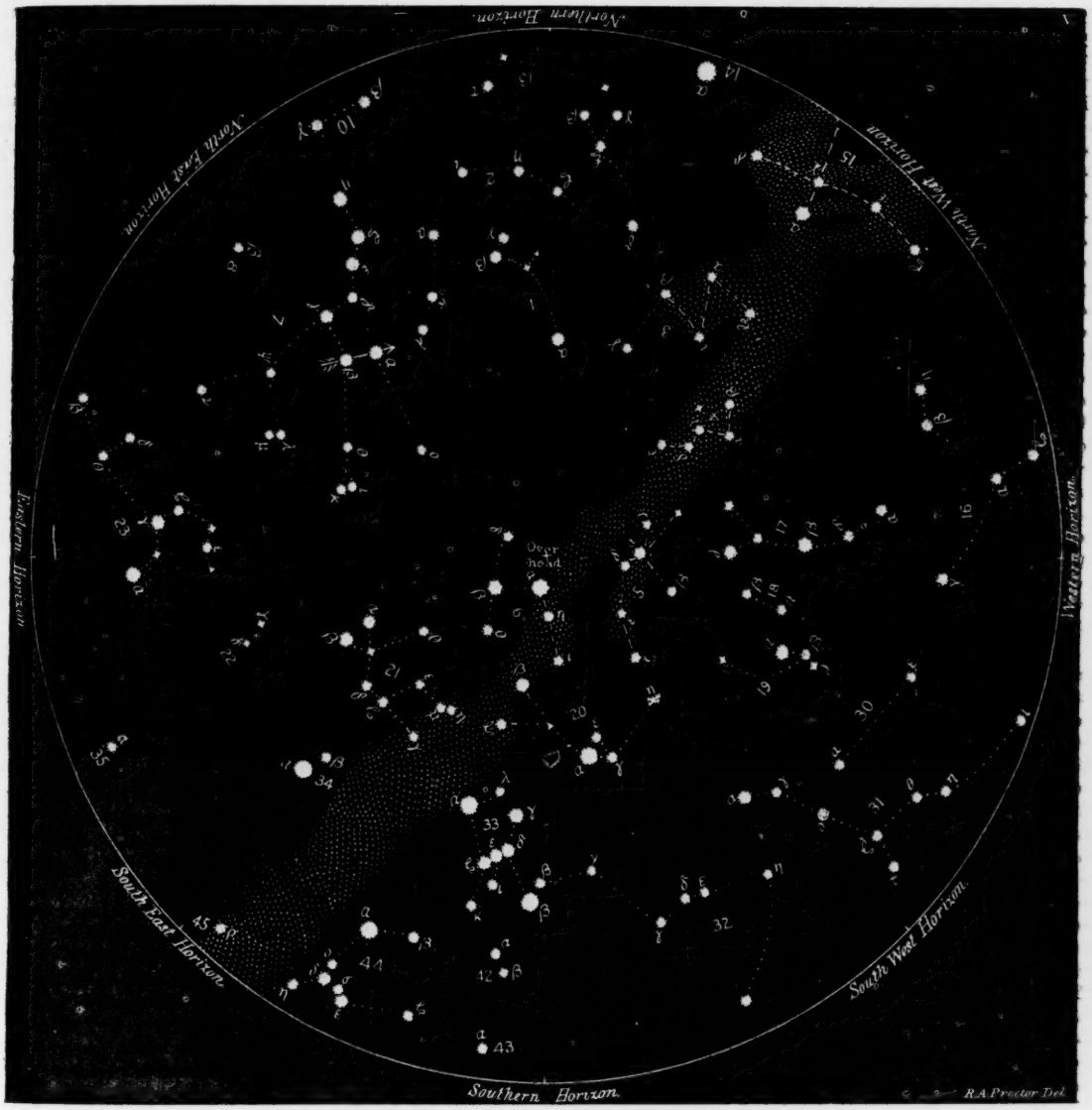
By Richard A. Proctor.

THE map of the stellar heavens, as presented this week, needs scarcely any explanation. It will be observed that the map has not, properly speaking, top, bottom, or sides; the centre represents the point overhead, the circumference marks the horizon. The stars of the first three magnitudes only are shown, and the constellations are numbered, not named. The numbering begins with the Little Bear, to see which in its proper position the map must, of course, be held with the "Northern Horizon" downwards. The other constellations are taken as nearly as possible in the order of their distance from the pole (α in 1 is the Pole star), from Draco, the Dragon, which being nearest the polar constellation is numbered 2, to Argo, the Ship, which being the farthest from the pole of all those included in this series of maps is numbered 45, the last number in our list. The constellations are also taken around the pole in the order of their right ascension,—or in the direction in which the hands of a watch move, around the North Pole, which in the southern skies means from right to left.

The constellations included in the set of maps are numbered throughout as follows:—

1. *Ursa Minor*, the *Little Bear* (*a*, the *Pole Star*).
2. *Draco*, the *Dragon* (*a*, *Thuban*)
3. *Cepheus*, *King Cepheus*.
4. *Cassiopeia*, the *Lady in the Chair*.
5. *Perseus*, the *Champion* (*β*, *Algol*, famous variable).
6. *Auriga*, the *Charioteer* (*a*, *Capella*)
7. *Ursa Major*, the *Greater Bear* (*a*, *β*, the *Pointers*).
8. *Canes Venatici*, the *Hunting Dogs* (*a*, *Cor Caroli*).
9. *Coma Berenices*, *Queen Berenice's Hair*.
10. *Boötes*, the *Herdsman* (*a*, *Arcturus*).
11. *Corona Borealis*, the *Northern Crown*.
12. *Serpens*, the *Serpent*.
13. *Hercules*, the *Kneeler*.
14. *Lyra*, the *Lyre* (*a*, *Vega*).
15. *Cygnus*, the *Swan* (*a*, *Arided*; *β*, *Albires*).
16. *Pegasus*, the *Winged Horse*.
17. *Andromeda*, the *Chained Lady*.
18. *Triangula*, the *Triangles*.
19. *Aries*, the *Ram*.
20. *Taurus*, the *Bull* (*a*, *Aldeburan*; *η*, *Alcyone*, chief *Pleiad*).
21. *Gemini*, the *Twins* (*a*, *Castor*; *β*, *Pollux*).
22. *Cancer*, the *Crab* (the cluster is the *Beehive*).
23. *Leo*, the *Lion* (*a*, *Regulus*).
24. *Virgo*, the *Virgin* (*a*, *Spica*).
25. *Libra*, the *Scales*.
26. *Ophiuchus*, the *Serpent Holder*.
27. *Aquila*, the *Eagle* (*a*, *Altair*).
28. *Delphinus*, the *Dolphin*.
29. *Aquarius*, the *Water Carrier*.
30. *Pisces*, the *Fishes*.
31. *Cetus*, the *Sea Monster* (*o*, *Mira*, remarkable variable).
32. *Eridanus*, the *River*.
33. *Orion*, the *Giant Hunter* (*a*, *Betelgeux*; *β*, *Rigel*).
34. *Canis Minor*, the *Lesser Dog* (*a*, *Procyon*).
35. *Hydra*, the *Sea Serpent* (*a*, *Alphard*).
36. *Crater*, the *Cup* (*a*, *Alkes*).
37. *Corvus*, the *Crow*.
38. *Scorpio*, the *Scorpion* (*a*, *Antares*).
39. *Sagittarius*, the *Archer*.
40. *Capricornus*, the *Sea Goat*.
41. *Piscis Australis*, the *Southern Fish* (*a*, *Fomalhaut*).
42. *Lepus*, the *Hare*.
43. *Columba*, the *Dove*.
44. *Canis Major*, the *Greater Dog* (*a*, *Sirius*).
45. *Argo*, the *Ship*.

An interesting article on "The Development of the British Coal-Field" (which should be read in its entirety) appears in the January issue of the *Manufacturer*.



NIGHT SKY FOR JANUARY (FIRST MAP OF PAIR),

Showing the heavens as they appear at the following hours:—

January 7 at 10 o'clock.	January 18 at 9¼ o'clock.	January 29 at 8½ o'clock.
January 10 at 9½ o'clock.	January 22 at 9 o'clock.	February 2 at 8½ o'clock.
January 14 at 9¼ o'clock.	January 25 at 8¾ o'clock.	February 6 at 8 o'clock.

THE YOUNG ELECTRICIAN.

BY W. SLINGO.

THE study of electricity has of late years increased so extensively that there is scarcely a youth who has not, to a greater or less extent, some acquaintance with it. There is, too, every prospect that as time goes on, the subject will still further increase in popularity. As, however, physical science is based upon experiment, it follows that to gain anything more than the merest smattering of the subject, something beyond a few hazy notions culled from indifferent sources is essential. It is necessary, as much so, perhaps, as in any other subject, that the study of the science should be practical, and that experiments should be worked to prove the various points laid down. I know of no better exercise than having a certain law in mind to devise apparatus in some form or other to prove its truth. But to the student who attempts unaided to unravel for himself the mysteries of electrical science, obstacles present themselves at every step. Books there are in shoals to teach him the principles and applications of electricity; some, too, describe in greater or less detail the construction of the apparatus employed; but he will look in vain for a work theoretically reliable, and, at the same time, mechanically explicit. In

other words, if he desires to make his own apparatus, and to perform his own experiments, he is left too much to his own resources, or to the tender mercies of shopkeepers who want their "shent per shent."

It is, however, very certain that the expenditure of money upon "cheap" (and exceedingly nasty) apparatus is a mistake. If economy be a material consideration, far better would it be to become one's own mechanic, or even to purchase the parts and put them together properly. The necessitous, however, are not the only students who find pleasure or satisfaction in constructing apparatus for themselves, for there is a solid gratification in working experiments with home-made instruments. Coupled with this gratification, is the assurance that the individual store of knowledge is being considerably augmented. Home-made apparatus should be, and often is, far superior to a large proportion of that which is exposed for sale in shop windows.

These remarks will render apparent my reason for undertaking this series of papers, in which it will be my object to enable my readers to make such apparatus as may be necessary to explain the various laws and applications of electricity, and to afford to the amateur a source of pleasurable employment not altogether devoid of intellectual profit. Points of theory will, as far as practicable, be eschewed. The plan will rather be to enunciate the laws generally accepted, and then to describe systematically the manufacture and application of such apparatus as may help to explain or verify the law. In order to render the work as complete in itself as possible, I purpose commencing with the more rudimentary portions of the subject, and then by following out a species of evolution in electrical instrument making, to attempt ultimately some of the most delicate and, withal, the most interesting pieces of apparatus conceivable.

It is only by practical experience that we become acquainted with the various little details in construction essential to the good and reliable working of the apparatus. To work well, apparatus should be made well, and we might just as feasibly expect a wooden horse to carry a man across the country as to expect a clumsily or carelessly-made piece of apparatus to behave as an orderly and well-conducted piece of machinery should do.

There are doubtless some parts of various instruments which the majority of amateurs could hardly hope to succeed in making. This, however, need not prevent them making all that it is possible for them to do, but when they find it necessary to call upon professional *skill*, let them be sure that they get it; and this they can only rely upon by going to a good establishment.

Before the student is able to prepare any experiments, it is necessary that he should provide himself with a few tools and sundries which he will require more or less frequently. Let us first, then, decide upon a small stock-in-trade, and in doing so, let us bear in mind that we are preparing for a series of experiments in the department of "frictional" or "static" electricity.

Ex. I.—One of the first necessities is an *insulating varnish*. This may be prepared in a small-necked, stoppered glass bottle of about 12 oz. capacity. Into this put about half-a-pint of methylated spirit, and in that dissolve shellac (previously broken into small pieces) until it assumes a consistency similar to that of ordinary commercial gum. Shellac is an exceedingly useful material, and a quantity of it, say a pound, should be kept on hand. The solution of the lac takes a day or two. When water is used as a solvent (not that water is applicable in this particular case), we may, generally speaking, increase the rate of solution by applying heat; but the spirit is too volatile for this to be done, and we must therefore be satisfied with such speed as we may get. When thus prepared, it is carefully stoppered and put away in a *cool* place to be called upon when required. It is sometimes said that the varnish will not keep, and that the spirit will evaporate; but I have some by me which I made two or three years ago, and which is as good now as when it was first made. Everything depends on the stopper. If it fits well it will prevent evaporation, and the partial solidification of the little varnish that happens to find its way into the neck should make good any shortcoming on the part of the stopper. A glass stopper is preferable to a cork, because the latter would very speedily get fixed irremovably. Shellac varnish answers best when used thin. If too thick the outer film is deprived of its spirit, and becomes practically solid before the spirit associated with the subjacent lac has had time to evaporate. Consequently a very long time is likely to elapse before the insulating coating becomes thoroughly dry and set. When a coating of considerable thickness is required, it is much the better plan to apply a succession of thin layers, allowing each one to dry before the succeeding one is applied. A little vermilion added to the varnish imparts a beautiful glossy colour, and such a varnish is far preferable to ordinary sealing-wax varnish, being so much purer. Shellac varnish is applied by a brush, which so long as it is kept clean may be allowed to dry after having been used. Immersion in the solution for half an hour or so will restore its pliability.

Ex. II.—Another insulator frequently required is paraffin-wax. This is a white, solid substance, to be by no means confused with paraffin-oil. When used, it is applied in the liquid state, and allowed to cool, which it does very speedily. As it is volatile, it is best not to raise it to too high a temperature when melting. The melting is generally accomplished by heating the wax in a small tin box, or even a saucer, over a spirit or Bunsen flame.

Substances to be coated with paraffin require, generally speaking, to be immersed in the molten wax. Sometimes a different course is pursued, but reference will be made to this when occasion requires.

Ex. III.—As a solid suspending insulator, nothing is superior to silk fibre, a small quantity of which will prove useful. Silk-thread and narrow silk-ribbon will also be requisitioned occasionally. The colour is practically immaterial.

Ex. IV.—Glass is, of all insulators, the one most generally employed when strength is a necessary quality; and half a pound of quarter-inch and a like quantity of half-inch tubing will be certain to prove useful. "Combustion," or hard flint glass, tubing (pale green in colour) is preferable to the soft tubing for straight insulators; but, where they are to be bent, the softer kind must, generally speaking, be resorted to. A small quantity of glass rod, quarter to half an inch in diameter, will also prove useful.

(To be continued.)

Patents.—The number of applicants for Letters Patent during the year just ended amounted to 17,110.

Bankruptcies in 1884.—Notwithstanding the fact that the past year has been one of universal depression, the decrease in the number of bankruptcies has been most remarkable. In 1883 the number gazetted for England and Wales was 10,183; last year there were only 3,721 persons declared bankrupt, or barely a third of the number of the previous year. In this statement of affairs there must be much that stands to the credit of the new Bankruptcy Act, for everything else has favoured an increase of bankruptcies. Whatever room there may be for improvement in details, it is very obvious that the new Bankruptcy Act is a success.

Editorial Gossip.

SINCE the second paragraph in this Gossip, on p. 12 was written I grieve to hear that the subject of the brilliant operation there referred to has died. Inasmuch, however, as his death was not referable to its performance, the moral to be derived from the whole history is in no way invalidated.

ON the first day of the present year the Astronomer Royal commenced the experiment of beginning the astronomical day at the same instant as the civil day, *i.e.* at the stroke of midnight of Dec. 31, 1884, instead of, as heretofore, at noon on Jan. 1. This was, of course, done in compliance with the decision come to by the International Prime Meridian Conference, on Nov. 1, ult. The second recommendation of the Conference, that the hours should be reckoned uninterruptedly from 0h. to 24h. had (as is pretty well-known) long previously been adopted at the Royal Observatory, the public dial at which has for some years indicated time in this fashion. It is much to be desired that this method of counting the hours should come into general use; which it certainly might do at comparatively little cost and trouble. The sole alteration absolutely necessary in our existing clock and watch faces would be the painting of the hours 13, 14, 15, 16, &c., under (or over) the 1, 2, 3, 4, and so on. I cannot help thinking that any enterprising watchmaker who would undertake either to supply fresh dials or alter existing ones, as suggested, at a cheap rate, might benefit himself, as well as the general public, very materially in this way. As for the convenience of the 24-hour reckoning, and the comparative immunity it affords from all chance of mistake, only those who employ it can appreciate it. Notably would it simplify "Bradshaw" (and other works in which time-tables form an element) very materially indeed, the attempted distinction between a.m. and p.m. in main-line trains being most confusing. It is surprising how soon the seeming oddness of the numeration wears off. I have no doubt that in a single week's time it would seem as natural to people to talk of dining at 19h. 30m. as it now does of breakfasting at nine or lunching at half-past one.

IT may be only a coincidence, but it struck me as odd to read of four consecutive accidents in different parts of England from the fall of rocks in quarries, happening concurrently with the terrible earthquake disturbances in Spain. May it not possibly be that the vibrations or undulations set up from the original centre of disturbance travelled across this country in so attenuated a form as to be imperceptible to the senses of those not specially on the watch for them, and yet with sufficient force to loosen fissured or overhanging strata?

I SEE that a Committee has been appointed to consider the question of the design and printing of the whole series of British postage-stamps. As they must, almost as a matter of course, recommend a very considerable alteration of the present unmeaning series, hard enough to distinguish in daylight, and indefinitely more so by lamplight, it is greatly to be hoped that they will urge upon the authorities the wisdom of engraving a *portrait* of the Queen upon the fresh issue. Why should we go on falsifying history, by sending forth to the world the picture of a girl of nineteen, as the likeness of a lady who is a great-grandmother!? When we hear of a semi-barbarian Emperor having it announced that he has sat down to meat, and that now all other earthly rulers may go to dinner, we laugh at the savage and worse than childish conceit which prompts the proclamation. Do the officials who are responsible for the present Queen's head upon our stamps, appeal—or try to appeal—to a similar barmaid type of vanity in their Sovereign, by representing her of the same age as her own grandchildren?

I HAVE received a paper by Messrs. Balfour Stewart and W. Lant Carpenter, which was read before the Royal Society on May 1, 1884, entitled, "A Comparison between apparent Inequalities of Short Period in Sun-spot Areas and in Diurnal Temperature Ranges at Toronto and Kew," in which the authors express their conviction that some evidence exists that "Sun-spot inequalities around 24 and 26 days (whether apparent or real), seem to correspond closely in period with terrestrial inequalities as exhibited by the daily temperature range at Toronto and at Kew." That the results differ strangely for the two stations is scarcely worth mentioning!; and I can only say that were I a magistrate, I should be very sorry indeed to send a tramp to gaol for a week's hard labour upon such "evidence" as Messrs. Stewart and Carpenter adduce. Their report, however, was originally made to that most paltry scientific sham, the "Solar Physics Committee"; which must continue to give *some* raison d'être, or the money grant to it, of which the wretched tax-payer's pocket is annually picked, would, perforce, be withdrawn.

Reviews.

SOME BOOKS ON OUR TABLE.

State Measures for the Prevention of Poverty, War, and Pestilence. By A DOCTOR OF MEDICINE. (London: E. Truelove. 1885.)—Our author's ideas as to the best method of stemming the tide of poverty which is flooding the land are, in effect, those of that unjustly maligned and much misunderstood author, Malthus; and are certainly practicable, which is more than we can say of his suggestions for the abolition of war—at all events, until an absolutely radical change occurs in human nature. His essay on the extinction of infectious diseases demands, and will repay, a careful perusal.

The Art of Leather Manufacture. By ALEXANDER WATT. (London: Crosby, Lockwood, & Co. 1885.)—Here is another of Mr. Watt's technical handbooks, distinguished by that thoroughness and completeness of treatment which characterised his "Art of Soap-making," that we reviewed on p. 312 of our last volume. After a short preliminary historical sketch of the art of tanning and leather-making, our author enters into the chemical theory of the former process; describes the anatomical structure of the skin; gives a detailed account of the various kinds of hides and skins which are tanned; and discusses the materials employed, as a preliminary to a very full description of every known method of tanning. He then proceeds to leather-making, currying, embossing, and fell-mongering; the making of parchment, vellum, and shagreen; describes gut-dressing and glue-boiling; treats of the utilisation of tanner's waste; and concludes the volume with a number of useful tables and a capital index. The work is at present unique in the technological literature of the subject on which it treats.

Aids to Long Life. By N. E. DAVIES, L.R.C.P., &c. (London: Chatto & Windus. 1885.)—How much length of life is a matter of Hygiene, the returns of the Registrar-

General abundantly suffice to testify; and, undoubtedly, millions have died, and will continue to die, in middle-age, whom reasonable care and precaution would have enabled to survive to a period exceeding that prescribed by the Psalmist. By all who wish at once to prolong and enjoy their lives, Dr. Davies may be accepted as a thoroughly safe and trustworthy guide. His description of the various disorders incident on advancing years, together with the remedies, pharmaceutical and dietetic, for their palliation or cure, leaves nothing to be desired. Notably, we think, is his Invalid Cookery to be commended, as showing how dishes may be made appetising, and, at the same time, absolutely therapeutic. The very moderate price at which this volume is issued places it within the reach of all who are interested in its contents: in which category every man or woman who has passed the age of fifty may fairly be included.

The Inspiration of the Bible. By H. L. Hastings. (London: S. Bagster & Sons.)—We must confess our astonishment at seeing the name of so well-known and high-class a firm as that of the Messrs. Bagsters on the title-page of such a collection of mere vulgar rant as this tract.

The Fern Portfolio. By Francis George Heath. (London: Society for Promoting Christian Knowledge. 1885.)—We have from time to time noticed isolated parts of this most beautiful work as they have reached us, and are now glad to find it issued in one volume by the Society for Promoting Christian Knowledge. The publishing committee of that Society may well congratulate itself on having been the means of bringing before the public a book which many persons will be glad to have, if it be only as an ornament to the drawing-room table. Superadded, however, to its merely ornamental characteristics is the merit it possesses of being the most absolutely life-like reproduction of all the species of British ferns that has ever been published. As affording the means of identifying our British ferns it is quite unsurpassable, and should, as it doubtless will, be forthwith procured by every one who delights in the grace and beauty of the Filices of these islands.

A Dictionary of National Biography. Edited by Leslie Stephen. Vol. I. (London: Smith, Elder, & Co. 1885.)—At once concise and full, containing everything essential to be known, without a superfluous line, the articles which make up Mr. Leslie Stephen's first volume may unhesitatingly be pronounced to be models of biographical literature. The most out-of-the-way sources of information appear to have been ransacked to provide the material for this fine work, and it may suffice to show the catholic spirit in which it has been undertaken, if we mention that in the present volume (extending from Abbadie to Anne) we find notices of lives of such diversity as those of King Ælfred and Bishop Acca side by side with those of Gilbert A'Beckett, the famous comic writer, and Jerry Abershaw, the notorious highwayman of the last century. The name of the editor, and the list of contributors prefixed to the volume before us, may of themselves be accepted as an earnest of the manner in which Mr. Stephen's scheme will be carried out. Assuredly if the future volumes of the series fulfil the promise of the present one, Englishmen will ultimately possess a biographical dictionary which will suffer nothing from comparison with anything that has previously been attempted in any language.

The Story of a Great Delusion. By William White. (London: E. W. Allen. 1885.)—*Forty-five Years of Registration Statistics, proving Vaccination to be both Useless and Dangerous.* By A. R. Wallace, LL.D. (London: E. W. Allen. 1885.)—We class these works together because they have a common aim—that of discrediting vaccination. It is simply pitiable to find a man of Dr. Wallace's intellectual ability in such company. He deals with statistics after the fashion of the small fanatical horde with whom he has thrown in his lot; and while admitting that it is difficult or impossible to tell whether a person who has died from small-pox has been vaccinated or not, tacitly assumes that every such person has been vaccinated. Mr. White proceeds on the time-honoured principle, "No case: abuse plaintiff's attorney," and alleges that Jenner was a dishonest hypocrite—in fact, little better than a rascal. This is a species of argument (?) which may satisfy a Leicester mob; it is hardly one to influence the candid and dispassionate inquirer.

Scientific Theology. By Thomas Walter Barber. (London: Elliot Stock. 1884.)—Mr. Barber travels, to some extent, along the lines of Professor Drummond's "Natural Law in the Spiritual World," in the work lying before us; but his knowledge of the latest results of scientific research, unfortunately, scarcely equals that of the author of the able essay referred to. For example, he hardly seems to grasp the modern doctrine of energy in its entirety. But his tolerance is admirable, and he is very far indeed from condemning the philosophic doubter to everlasting fire. Readers may differ from him in some of his conclusions, but they will all admit the large charity with which such conclusions are advanced.

The Student's Elements of Geology. By Sir Charles Lyell, Bart., F.R.S. Fourth Edition, Revised, by P. Martin Duncan, F.R.S. (London: John Murray. 1885).—There is small need to occupy space by any attempted introduction of a work which has long been recognised as absolutely indispensable to every student of geology. The first edition of the volume lying before us appeared in 1871, and was recast by its great and lamented author from his classical "Manual of Elementary Geology." The second edition appeared in 1874, the third in 1878, and now the exhaustion of the last one has rendered the production of this fourth edition imperative, and to Professor Duncan has been entrusted the task of its revision, and the bringing of the information it is intended to impart down to the latest date. Sir Charles Lyell's pleasantly-written and profusely-illustrated work has suffered nothing at the hands of its latest editor, who seems to have successfully embodied the latest results of geological investigation in such additions as he has made. This is emphatically a volume which no student of geology can afford to be without.

The Year-Book of Photography, and Photographic News Almanac for 1885. Edited by Thos Bolas, F.C.S. (London: Piper & Carter).—By excellent systematic arrangement, and by the use of small type, Mr. Bolas has contrived to pack an amount of information between the covers of this year-book which may be fairly described as astonishing. Every improvement which has been made either in apparatus or photographic processes during the past twelve months will be found here recorded. Amateur and professional will alike discover that his wants are supplied. The astronomer will find something about stellar photography; the very beginner directions how to test a lens. Every possessor of a camera will, merely as a matter of course, buy this book.

Transit Tables for 1885, &c. By Latimer Clark, M.I.C.E. (London: E. & F. N. Spon. 1885.)—Furnished with one of Mr. Latimer Clark's excellent and inexpensive transit instruments, and the little volume of tables whose title heads this notice, the most inexperienced observer may speedily be in a position to determine his time within less than a half-second. The advantage of this in outlying places must be very obvious indeed. Londoners have the Great Clock at Westminster to which to appeal,

but the dweller on Salisbury Plain or Cannock Chase may have many miles to travel ere he reaches a post-office to which Greenwich time is flashed. Moreover, merely as an introduction to practical astronomy, the use of the transit instrument possesses both value and interest.

Our Camp. The Christmas number of the *Cyclist.* (London: Iliffe & Sons.)—If it be objected that our notice of this Christmas number appears full late, we may perhaps urge that this is of the less importance, since by this time every cyclist in the kingdom has probably bought and had his shilling's worth of laughter out of "Our Camp." It contains three large cartoons filled with portraits of everybody who is anybody in the wheel world. The supposititious pages from the different cycling periodicals are clever caricatures.

The Tricyclist. (London: Iliffe & Sons.)—We mention this paper here inasmuch as a series of articles on tricycle touring has just been commenced in its columns, which supply really valuable information to those about to employ this very agreeable means of familiarising themselves with the beauties of their own country.

The Comprehenscia Series. Letters to a Friend in Fleet-street. Red, Blue, and Yellow. (London.)—This is "a familiar description of a lecture delivered before the Balloon Society," which is apparently a species of refuge for the scientific destitute. We hope that the society was edified. For ourselves the author passes our "comprehenscion" altogether.

Ward and Lock's Technical Journal. Part II. (London: Ward, Lock, & Co.).—The second part of this serial fully sustains the promise of the first. There can be no doubt as to the place the work will ultimately take in technical literature.

We have also on our table *The Proceedings of the Academy of Natural Sciences of Philadelphia. Ciel et Terre, Bradstreet's, The Season, Sunday Talk, The Launceston (Australia) Examiner, Who made the New Testament? The Medical Press and Circular*, and from Messrs. Cassell & Co. their *Household Guide, The Countries of the World, Cassell's Popular Gardening, The Book of Health, European Butterflies and Moths*, and *The Library of English Literature.*

Miscellanea.

RAILWAYS IN EUROPE.—It is computed that there were 52,000 locomotives upon the railways of Europe in 1882. The number of passengers carried during the year was 1,371,000,000, while the aggregate weight of goods carried was 715,000,000 tons.

THE QUEEN has been pleased to present to the funds of the Booksellers' Provident Institution, through Sir Henry Ponsonby, K.C.B., a donation of £20. Her Majesty has been the Patron of the Society since the year 1868.

MESSRS. WYMAN & SONS are on the point of issuing a remarkable little brochure under the title of "The Siege of London," by "Posteritas." We understand that there is a probability that the work will cause a sensation, as it is in the nature of a warning and a prophecy.

FOUR years ago there was but one telegraph line in China, namely, Shanghai, to the sea. Now the capital of Southern China is joined with the metropolis in the north; and as Canton has been put in communication by telegraph with the frontier of Tonquin, the telegraph now stretches in an unbroken line from Pekin in the north to the most southern boundary of the Chinese Empire, and a message either from London or Pekin might reach the headquarters of the Chinese forces on the Tonquin frontier in a few hours.

WE have received from Messrs. Davidson & Co., of Jewin-street, some remarkably effective relief cards, which form pretty and novel toys if inserted in wooden stands, or serve capitally to fill a juvenile scrap-book. They chiefly represent the old nursery legends, which are illustrated in coloured bas-relief. Some larger ones depict fire-engines, a fire-escape, and an omnibus. They are all spirited, artistic, and wonderfully cheap, and are something quite new for the youngsters.

WE have also received from Messrs. Unwin Brothers, Phillips's Acrostic Loto, a game in which instruction is combined with amusement to an extent that might almost justify its ingenious inventor in putting it forth as a very agreeable mode of cramming for a competitive examination in history, biography, and general literature. Seriously speaking, though, the man who can win at this game by his quickness in recognising the members of the Acrostic which is dealt to him must possess an amount of diversified knowledge such as falls to the lot of but few merely desultory readers, and any one who will play steadily at it until he has mastered the whole of the answers will find that he has added very materially to his stock of information.

MESSRS. ALEX. WILSON & CO., Vauxhall Ironworks, London, are at the present moment completing a small steam-launch for the use of the Thames Police to enable them to patrol the river more effectually than with the rowing boats now in use, an example which will no doubt be the precursor of several others for the same duty. The decision of the authorities to use steam-launches was arrived at some little time ago, and the recent explosion at London Bridge will no doubt confirm them in the wisdom of adopting steam for river patrol purposes. The easy management, small and inexpensive consumption of fuel, and the speed such craft can attain will greatly assist those in command to reconnoitre the river, guard the bridges, wharves, shipping, warehouses, and public buildings, whether by day or night, against dynamiters and thieves. They will increase waterside security, allay the anxieties of insurance companies, and afford more reliable protection to public and private property than has been the case previously.

THE Mersey Tunnel is now completely arched in under the river with the exception of the inverts. It is interesting to geologists to know that, about 300 yards from the Liverpool side, the upper part of the tunnel intersected the pre-glacial bed of the river for a distance of about 100 yards. This gully in the rock was filled with hard boulder clay, with erratic boulders resting upon the hard denuded surface of the triassic sandstone. This pre-glacial gully was, in opposition to the prevailing opinion, foreseen and predicted as one of the difficulties that would have to be encountered in the tunnel works in a paper by Mr. Mellard Reade, entitled "The Buried Valley of the Mersey," published in the "Proceedings" of the Liverpool Geological Society in 1872.

THE EVILS OF PATENT MEDICINES.—The advantages, in the way of Free Trade, of the existing Patent Medicine Law, are forcibly illustrated by the report of an inquest, held last week at Weymouth, relative to the death of Charlotte Bennett, aged 33 years. It appeared from the evidence that the deceased was suffering from mental depression respecting religious matters. She was eventually found in a comatose condition. She had an empty glass in her hand, and three empty bottles were found in the room. Medical assistance was obtained, but death ensued a few hours afterwards. From the evidence of several chemists' assistants, it came out that they had, without hesitation or any inquiry whatever, sold several 4s. 6d. bottles of a well-known patent medicine at short intervals to deceased, and had been in the habit of selling 11s. bottles. In fact, the deceased had bought from persons who had no knowledge of her as much as would stock a large shop, and the persons who had sold it to her considered that the sale was "all in the way of business, because, being a patent medicine, it was not—legally—a poison.—*Medical Press and Circular.*

IN their trades report, Messrs. Bolling & Lowe, speaking of street and road tramways, say, although only an investment of about fifteen' years growth in this country, they have already had great success. As consumers of materials in iron and steel, carriages, and locomotives, they are playing an important part, and one capable of infinite development. The gravitation of population is always towards towns, and tramways have the advantage of starting with free land, and are unencumbered by stations, signals, telegraphs, and other expensive requirements of railways. Traffic is rapidly increasing, and the use of locomotives effects a considerable saving as compared with the employment of horses. The following official figures illustrate the progress in the United Kingdom:—

	30th June, 1883.	30th June, 1884.	Increase during the 12 months. Per cent.
Capital expended	£9,929,789 ...	£11,008,121 ...	12 7/10
Miles	671 ...	752 ...	12
Horses	20,122 ...	21,784 ...	8
Locomotives	117 ...	207 ...	77
Cars...	2,819 ...	3,038 ...	7¾
Passengers carried ...	295,721,171 ...	330,794,405 ...	11⅛
Net receipts	£459,613 ...	£568,716 ...	24
Average net earnings	£4. 14s. p. c. ...	£5. 3s. 4d. p. c. ...	9s. 4d.

Our Inventors' Column.

So great is the number of inventions now patented that many good things are comparatively lost in the crowd. A succinct account, therefore, by an Expert, of all inventions of really popular interest and utility must be advantageous both to the public and the Inventor, enabling persons to hear of inventions already desiderated by them, and thus acting reciprocally as a stimulant on supply and demand.

IMPROVEMENTS IN OPEN FIRE-GRATES.

The fire-grate, in all its phases, is apparently an inexhaustible field for the ingenuity of inventors. The main objects of the invention named above—that of Mr. Samuel Pickersgill, of the Star Foundry, Eagle-street, Derby—are to facilitate the heating of an apartment, to economise fuel, and to prevent ashes or fire falling through the bars on to the hearth, and, as a general consequence, to promote perfect combustion. The bars at the front are so bevelled inwards as to make it impossible for the ashes either to lodge on them or to fall through upon the hearth. The ashes are thrown forward into the fire, and either consumed or caught in a hidden ashpan, which may be removed without causing dust. The bottom of the fireplace is formed partly of iron bars and partly of firebrick; it is attached to the back, also made of firebrick, shaped so as to stand into and contract the fire space for four or five inches, and then recedes, and the peculiar shape is such as to cause a large part of the smoke to be consumed. The bottom of the fireplace, instead of being formed partly of grate and partly of firebrick, may be formed wholly of firebrick, which does not involve alteration of shape. The ashpan may, however, then be dispensed with.

PALMEIRA TABLE-WATER.

The number of potable waters increases apace, we mean waters wherein Nature is more or less aided by art and hygienic science, and not a little invention has to be expended in fixing on distinctive names for each new competitor in the now crowded list of our table-waters. The Brighton and Hove Co-operative Supply Association has just introduced what is known as the Palmeira Table Water, an aërated drink pronounced to be of considerable dietetic value. The water is distilled, and this reminds us that the subject of the importance of using distilled water has lately been emphasised by some of the highest authorities in the scientific world. There is no solvent, after all, like water, hence most waters include a vast quantity of suspended solid matter frequently most injurious to the drinker. Distilled water is not only entirely clear of anything of the kind, being emphatically the very "softest of soft water," but it has extraordinary power itself as an active solvent, and helps to carry off out of the system of those who use it very much deleterious matter. This alone should greatly help to popularise Palmeira Water.

GAS-STOVES AND ASBESTOS FIRES.

In few lines of inventions, perhaps, has such marked progress been achieved as in gas-stoves and asbestos fires. Among the new designs put forth for 1884-5 by Messrs. John Wright & Co., of the Essex Works, Broad-street, Birmingham, is the Kirl Ventilating Gas-Stove, which has the advantage of an open fire. Among the special advantages claimed are:—1. Perfect freedom from smell. 2. Perfect ventilation secured by the introduction of pure external air into the apartment to be warmed. 3. The greatest heating power from a given quantity of gas. 4. Durability, economy, elegance of design. Another speciality of this firm is their Asbestos Incandescent Fire. This form of gas-stove is made on the most approved principle, and forms one solid sheet of flame, which plays over a back of fire-clay covered with the finest fibre asbestos. This asbestos is put on after the fire-clay has been burned, and thus its nature is not destroyed, as is the case with many stoves, and the incandescent effect obtained is far more brilliant. The asbestos is protected by an ornamental grille. Every stove is provided with a flue. These stoves are constructed on the interchangeable principle, so that any part may be replaced at any time. This also applies to the asbestos fibre, which can be attached by any one.

"GRIP" BOOTS AND SHOES FOR ICE.

Now that we may soon look, for a time at least, to ill-clad paths and roadways, a special interest attaches to an invention recently patented by Mr. John Lilley, of Wade Lock, Uppermill, Saddleworth, Yorkshire, designed to prevent boots or shoes from slipping even on ice. The invention consists of a nail with a spear or spade-shaped head which is fixed by a peculiar system of using a metallic tube so as to prevent injury to the head when driven in by a hammer.

These nails, which are intended to prevent people slipping when walking on frozen roads, may be fixed to boots or shoes such as ordinarily worn, or can be fixed to boots or shoes that may be worn in addition to the ordinary boots or shoes. In the latter case the use of such nails may conveniently be dispensed with when not required on any part or portion of road or when entering a building. The nails have a spike at one end, and at the other a spear shaped end or head. In the centre or midway between the two ends of the nail a solid ring or collar of metal is formed, on which, when the nail is driven into the sole of the shoe or boot, the sole rests on one side, and the bottom part of the head rests on the other side, the spike end of the nail being driven either into the sole or heel portion or both of the boot or shoe as many nails being used as may be found convenient. The holes in the sole, or underneath part of the shoe, are made by means of an awl or other suitable tool, and in these holes one end of the nails is fixed. A metal tube is then placed on the upper part of the ring, by which means they can be driven into their place by a hammer without injury to the end or head which rests on the ground.

POLISH STAINS FOR WOOD.

A wood-staining substance requiring no preparation, no varnishing, &c., has long been a desideratum to many. The Torbay Paint Company, of Brixham, Devon, whose London offices are at 27, Billiter-street, E.C., have recently introduced a novel and singular kind of wood-staining, which, while wearing very well, does not entail, it is said, any preliminary process. Assuming that the flooring is dry and clean, one coat of the stain, without any sizing, effects the object; and the stain appears not only to incorporate itself with the wood and dry quickly, but leaves a beautiful glossy appearance, bringing up the grain of the wood without concealing it, and producing a better imitation than many copies of real wood by graining. The stains are supplied in light and dark oak colours, mahogany, &c. In view of the increasing use of square carpets, this new polish should be, we think, very popular.

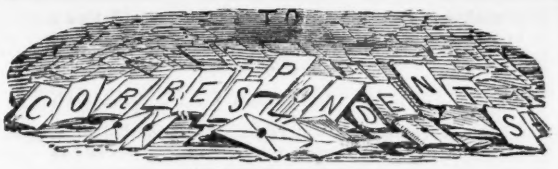
A TRAVELLER'S READING LAMP.

Railway carriages and public vehicles generally are very ill-lighted, and many persons, we think, will appreciate an invention recently placed on the market by Mr. Alfred Parkes, of Wolverhampton, known as the "Solar Reading Candle Lamp," and having for its special feature a grip vice, whereby it is held on to the cushion of a seat or other support. The grip has a force of twelve pounds, rendering the hold absolutely secure, though at the same time there is sufficient "give" to prevent flickering of the light from the vibration in travelling. The stand is telescopic, enabling the light to be adjusted to any required height, and when not in use the whole packs up in a box 3 in. wide by 1½ in. deep, and is thus particularly portable. Beyond the applications of the lamp referred to above, it will prove extremely useful in a library, invalid's room, &c., and it should be added that its general appearance is elegant and even artistic.

VENTILATION.

Of improvements in ventilation there seems to be literally no end. In this direction a rather notable advance has been made, however, by an invention of Mr. George W. Webb, of 1, Blagrave-street, Reading, which is designed to utilise the heated gases from gas during combustion, for carrying away the combusted products of the gas, and thoroughly ventilating billiard and other rooms where much gas is used. Funnels are used, which are specially placed above a shade for receiving into iron pipes all vitiated air, tobacco-smoke, &c. The heat from gas warms the funnels, and causes them to suck the foul air from all parts of the room towards them. It is then conveyed into a foul-air chamber, and drawn off by means of one of the exhaust ventilators. These extracting ventilators, which are self-acting, are exceedingly powerful, and are, of course, fixed in the roof. Each ventilator comprises five chambers arranged over the uptake shaft, so that the various parts are so beautifully balanced that the softest breeze acting on them from any part produces a partial vacuum, and draws the foul air, &c., after it. They have no mechanical movements, cannot get out of order, require no attention, and are continually working during all atmospheric changes of the weather. This system seems particularly well suited for public buildings of all kinds, for warehouses, shops, &c.

An Early Australian Locomotive.—The first passenger locomotive landed in Australia is now deposited in the Technological Museum, at the Sydney Domain. It reached Sydney Jan. 13, 1855, and during its career ran 383,636 miles. It was made by Messrs. R. Stephenson & Co., Newcastle-on-Tyne.



"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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THE ORIGIN OF MYTH.

[1555]—Mr. Edward Clodd, in your valuable paper, reviews Custom and Myth in a way which so entirely coincides with my ideas on these interesting subjects, that I cannot help offering a short remark thereon. To the believer in the theory of evolution of mind as well as body, it must be clear that, given the same surroundings or conditions of development, the results must be identical; hence, men emerging from apedom into brute-men, formed their first ideas all over the world, on divine higher matters from things which seemed higher and beyond their reach, viz., sun, moon, and stars. The traces of this universal worship of heavenly objects as the highest conception at a certain time of a deity, run through almost all religions. Volney, quoting from Porphyry, says:—"The majority of the philosophers imagine there never to have been any other world than the one we see, and acknowledge no other gods of all those recognised by the Egyptians, than such as are commonly called planets, signs of the Zodiac, and constellations, whose aspects, that is, rising and setting, are supposed to influence the fortune of men, &c.

"All these philosophers believe that the acts of our will and the motion of our bodies depend upon those of the stars to which they are subjected, and they refer everything to the law of physical necessity, which they call destiny, or fatum, supposing a chain of causes and effects which binds—by I know not what connection—all beings together from the merest atom to the supreme power and primary influence of the gods; so that, whether in their temples or in their idols, the only subject of worship is the power of destiny."

It appears to me, from this view of phenomena have sprung all ideas of an almighty Providence, &c.; it is, in fact, a personification of this idea. If there is a Providence, there can be nothing accidental. I always smile at the *logic* of such verdicts—(1) death by accident; (2) death from natural causes—when Christians ought to say by Providence. If there is an almighty will, there cannot be a free will! There remains a mechanical force, a chain of necessity, a fate, evolving mind and body. F. W. H.

CROMLECHS.

[1556]—"The cromlechs are, without doubt, the burying-places of the chiefs of these early tribes," Mr. Harrison, in KNOWLEDGE, page 483. It is certainly the general opinion that this is so; but not by any means the universal one. Miss C. Maclagan, F.S.A.S., published in 1876 a work arguing that *all* Megalithic remains are strictly architectural, *i.e.*, were built to live in; and others have taken the same side. A diligent study of the numerous ones in this neighbourhood conuinced me before I had read anything that this is the right view.

1. They were built by men unacquainted with any cutting process. No stone of them bears any trace of a tool. Is it conceivable that such very early men would go to such immense labour for the dead?

2. If they did, where are their own houses? Without bricks, cut stone, or timber, they could not build better ones than the Megalithic structures which remain.

3. I know a chamber composed of four great stones about five feet high; the roof is an immense sea-worn slab. Between it and the tops of the walls is a course of masonry very tightly built without mortar, whose sole effect is to raise the roof so far as to allow of ordinary men standing upright. Why all this trouble, if the dead only were to be accommodated?

The belief that they are built for tombs arises from the fact that tombs they certainly have been, as is proved by the regular interments that have been made in them. But this is no proof. In Champagne a whole range of rock-cut chambers was found, all full of skeletons. In this case, however, it is certain that the dead were not the first tenants. The rock is soft; all the thresholds were worn by the passage of countless feet. Did the dead go in and out thus? Again, pegs had been left in the rock. Were these for the dead to hang up their grave-clothes while they larked about till cock-crow?

The better creed seems to be that, when caves grew scarce, primitive man took a lesson from the birds and bees, and built him "man's-nests." When men became able to build better (and less durable) dwellings, which allowed them fire-places and windows, what was to become of the old, indestructible tumuli? To stow away the dear departed in them was an obvious idea. Later, they became sacred spots; the *megara* of Greece, into which animals were let down on high-days, were very probably these mound-dwellings, of which cromlechs, menheis, and dolmens are but single denuded vertebræ.

The entrance to the mound is very generally to the east, because the inhabitants had then the first note of day. It is a hole, half up the mound, between two blocks, which are always of white quartz, if attainable. Why? Probably the hole was blocked by a bush. A denizen returning in the twilight (perhaps hard pressed by a wild beast) would be guided to the haven of safety by the glimmer of the white stone; up with the dead bush, and lo! the chase has disappeared into the earth.

In a previous sentence Mr. Harrison suggests that the hill-camps near Pwlheli were "possibly erected by the ancient Gaelic inhabitants during the troublous times in the fifth and sixth centuries, which followed the departure of the Romans." Now, this is like saying "by the mice . . . . departure of the cat." The Picts and Scots harried the northern Britons; but who could have troubled the western? The English had never got so far. I should say these hill-camps are more likely at least 3,000 years old.

HALLYARDS.

P.S.—Apart from the main subject, it may be interesting to record a stone near here which tells something of the far past. For the last few millennia it has been doing duty as door-post of a tumulus. On its face are no less than seven parallel lines of erosion by water, and one line at right angles. These lines could not have been made by the sea, the stone remaining on the beach, before the mound-builders chose it for their purpose. I conclude that it was embedded in a small ice-floe at the close of a cold period. The sea must have been very calm,—more so than this land-locked bay is now; as it would be, indeed, if nearly filled with drift-ice. The ice must have been disappearing year by year. Each water-line shows the winter-level of the floe; then the summer comes, the floe partly melts, and the stone is each succeeding winter deeper in the water, and a new line is cut by the calm winter ripple. Finally the floe topples over, and in the last winter of its existence the stone floats at right angles to its first position. The floe grounds, and the stone is left above low-water-mark. Presumably, the ice has vanished from the sea; and it is after—one cannot guess how long after—this change of climate that men came and carried this and other stones a hundred yards up-hill to build a shelter with.

It is curious to note that man's first efforts as builder have proved the most durable and serviceable after all. Nobody could live in the Pyramids, and these tumuli are ages older than they, yet are still as habitable as the cut-stone houses of Bashan. In Auvergne the shepherds live much in the dolmens. I knew many for which an officer at Aldershot or the Curragh would be only too thankful, and so durable are they that their removal would not be paid by the value of the land for cultivation. I should like to build a house on one of these mounds—the megalithic chambers would make capital cellarage.

I have sought over miles of rocks on the coast without finding one bearing the peculiar water-marks mentioned above; erosian of *stationary* rock always leaves the base receding beneath an overhanging brow; the ancient sea-beach at Tunbridge Wells (the High Rocks) is an admirable instance. It is easy to see why. The lower parts are hammered by both flow and ebb, while the higher parts are reached only about high water.

Pornic, Loire Inférieure, France, Dec. 17, 1884.

WHAT IS AN INVENTION?

[1557]—I never could quite understand or appreciate rightly the especial value of *novelty* in an invention. Supposing the invention beneficial, I do not see why I should not value it, irrespective of the

consideration that it became known to mankind half a century ago, if it is only now that for the first time I am benefited by it. But, if I pique myself on knowing every new thing that comes out, at least as soon as any one else, I am reasonably offended at having anything presented to my notice as new which I have known, tried, and, perhaps, discarded years ago.

Is not the "Ideal" lamp, which was noticed so favourably in your "Inventor's Column," the same, to all intents and purposes, if not identically, as the one of which I here annex a figure, which represents a lamp now on my table, where it has served its purpose, on and off, for some three years? I also give below it the figure of the so-called "Ideal" lamp, which is obviously a faithful copy—exact in outline and shading, differing only in the sharpness of impression, Surely it verges on the absurd to offer the "Ideal" lamp as a *new* invention.—I am, yours faithfully, J. HERSCHEL.

Collingwood, Dec. 22.

[Colonel Herschel appends to his letter two woodcuts, one representing the "Empress" lamp, and the other the "Ideal" one. They are, as he says, absolute facsimiles, the one being seemingly printed from a cliché of the woodblock of the other.—ED.]

A SELF-LIGHTING GAS-BURNER.

[1558]—I was amused to see in your "Inventor's Column," of Dec. 26, an item *re* "A Self-Lighting Gas-burner and Tap." The idea is far from new, and is also unnecessarily complicated. The same object would be achieved by the very simple device of making the usual tap so that it could not be *entirely turned off*, and thus leave a minute light always burning. This plan obviates the necessity for a second burner of any kind.

Years ago I had such a burner and tap as you describe from a Mr. Weston, of this town, who had patented it. I found it to answer very well, except that the small light was liable to be blown out, which, of course, was fatal to its use. The patentee then made a rather ingenious sheath or cap to protect the small light; but, in the meantime, I had taken out the plug of an ordinary gas-tap, and in three minutes I filed a small channel round it, so that it let a little gas escape when the tap was turned off, and hey, presto! I had the "very thing." I have had this tap and burner burning in my bedroom now for a number of years, and, being protected by a globe, it has never once been blown out. It answers every purpose; we have only to turn the tap "on" to have a light; and when it is turned "off," sufficient gas still comes through to maintain a small and invisible light, costing, as near as I can estimate, about one penny per month. I have Mr. Weston's "improved" invention still in use in the cellar, but, in spite of its protective cap, it has been out several times (filling the cellar with gas); and another objection to it is, that the small light in time enlarges its orifice and allows too much gas to come through. I believe Mr. W. has remedied this objection also, but, as my simple plan leaves nothing to be desired, I have not tried his last improvement. WILLIAM PICKARD.

Sheffield.

MATTER.

[1559]—Mr. F. Routledge, letter 1543, asks what basis can there be for the statement of Hæckel on atoms having an unalterable nature, &c. I reply, the answer is contained in his own letter, viz., "it is an inference which he (Hæckel) thinks it fair to make from his experiments." I quite agree with Mr. Routledge that the mere statement of authority, although he be the Pope claiming infallibility, has not any claim upon our belief, unless the statement be in accordance with reason and logic. But Mr. Routledge goes too far; he asks us to accept his *ipse dixit*, instead of Hæckel's statement derived from experimental experience.

Mr. Routledge quotes Professor Clifford's "Ethics of Belief," to prove what? That Hæckel's opinion on atoms is an error of judgment? No! Hence I ask, how does Professor Clifford's authority apply?

It is conceivable to Hæckel, and to myself also, that attraction and repulsion are concomitants of pleasure and displeasure. I am attracted to things I like, or derive pleasure from; is it then unreasonable to conclude that like causes act in atoms? That like effects are produced by like causes; that atoms, even if unconsciously, like each other, and are thereby attracted; or dislike each other, and are thereby repulsed? In conclusion, "the fear of consequences" ought not to enter the field of honest research; let us have the truth—it is our Haven of Rest. F. W. H.

[There is a verbal ambiguity in the word "attracted," as used by "F. W. H.," which materially impairs the force of his argument. To say that a man being "attracted" by a beautiful object is an analogous thing to a needle being "attracted" by a magnet, is to be guilty of the *Fallacia equivocationis* of the Schoolmen.—ED.]

THE CARNIVOROUS PARROT OF NEW ZEALAND.

[1560]—Your readers will perhaps be interested to read the following extraordinary action of a New Zealand species of parrot called a *Kia*. While engaged in laying out the survey for a line of railway in the mountains at Arthur's Pass, one evening, the men set out to return to their camp, taking a track over the mountain instead of through the dense bush. They were followed by a very handsome jet-black sheep-dog, belonging to one of the men. The dog, having lagged behind, was presently heard yelping and barking, and the owner went back to assist, thinking it might have fallen among the rocks and hurt itself, but it soon came up to him, carrying in its mouth a mangled kia, and then the dog was found to be severely torn and pecked on the loin. The parrot had evidently swooped down on the dog and commenced its depredation, as the kias are accustomed to do to the sheep with invariably fatal result, but the dog, after recovering from its surprise, must soon have succeeded in getting hold of the bird. This species of parrot keeps to the higher parts of the mountains, mostly near the snow-line. It has lately become a terror to shepherds from the numbers of sheep it kills, by tearing open a hole in the loins and eating the kidney fat. Of late the sea-gull has joined the parrots in killing lambs and sheep, and we hear that even horses are occationally killed by sea-gulls when found helpless in the snow. The Kia is the only parrot I ever heard of that attacks a living animal; but it is observed that all New Zealand wild birds, including the handsome little parrakeets, have a propensity for eating raw meat, greatly preferring the gut. I have seen the carcase of a sheep hung up to a branch at a diggers' camp so covered with parrakeets, robins, bush canaries, and fantails, that nothing of the carcase could be seen except the legs and hoofs. C. N. BELL.

Christchurch, N.Z.

[See KNOWLEDGE, Vol. I., pp. 381 and 471.—ED.]

LETTERS RECEIVED AND SHORT ANSWERS.

F. T. B. I think that if you will consult any of our contemporaries who give reviews of books, you will find that the appending of prices of works to the literary notices of them is never practised. To introduce such an innovation might be to supply certain readers of KNOWLEDGE "with as much information as *they* require," while others might wish to know the size, number of pages, and style of binding or covering of the volume noticed, and so on. The more the merely commercial element is dissociated from criticism, the more likely is such criticism to be honest and unbiassed. The object of every one who writes notices of books in these columns is, I verily hope and believe, to give an absolutely impartial opinion of their contents; in entire disregard whether such opinion makes or mars the sale of the work under review.—JOS. M. Luminous paint is made for out-door use, and is then mixed, I believe, with some oil medium. That sold in small bottles, which is, as you say, mixed with warm water, is for experiments indoors. Carriage-gates, &c., have been painted with the oil-paint, and have stood, I understand, very well.—GEO. HAILEY. Will be dealt with in Article XVIII. on "Electro-plating." Please see paragraph, in capital letters, which concludes the heading of the Correspondence Columns.—W. M. STURROCK. Could you furnish a *very* short *précis* of facts?—J. FARRAR. I cannot describe the photophone at length here; and can only say that it is an extraordinarily ingenious piece of apparatus for transmitting sounds through the mediate action of light on the curious metal Selenium. I am ignorant of the meaning of the word "Karoo."—THOMAS FOSTER. *If* the printing of the letter of "H. L." in the same type as the articles on p. 439 of our last volume did mislead any one into the belief that your series of essays were in any sense whatever intended as a reply to that writer, I quite feel that I should apologise to you. It never, however, occurred to me then—and I am very loth to believe now—that the mere fact of the difference of type in a communication so obviously taking the form of a letter was calculated either to originate or foster such a delusion.—HUGH CLEMENTS. Thanks; but enough has already appeared about your "Weather Cycle" in these columns. E. D. GIRDLESTONE. As there is no more familiar fact in optics than that the colours of objects have their origin in the absorption of certain rays of the spectrum and the reflection of the remainder, I rather fail to perceive precisely what you are driving at. See Sir John Herschel's "Familiar Lectures on Scientific Subjects."—R. T. SHEA. The best book on the subject is Davies's "Preparation and

Mounting of Microscopic Objects." I hope that our esteemed contributor, Mr. Slack, will include some directions for preparing and mounting objects in his interesting series of papers. I am not sure that an article on Bookbinding would be easy to obtain. It is an art, the technical knowledge of which is confined to a very limited circle. I reciprocate your good wishes.—EXCELSIOR (who appears to have been more fortunate in the north of England than we have been in the south) writes that a splendid sun-spot was visible to the naked eye (defended of course by coloured glass) on Christmas-day; other spots also being perceptible on the sun's disc. The sun-spot maximum has undoubtedly passed now. It probably occurred in 1883-4.—ROWLAND WARD, F.G.S., and W. WESTGARTH. Received.—E. HOWARD BIRCHALL. All saline matter must be carefully soaked out of sponges, or they will never dry at all.—J. W. ALEXANDER. Hæckel's æther must be the interstellar æther and nothing else. Your notion that the latter is "an attenuated gas" seems peculiarly wild, inasmuch as it must possess properties such as no gas does or ever could possess. Can you not see that the ejection of a stream of meteors from a sun (or planet) may have been a continuous operation—*Parva componere magnis*, Vesuvius and Etna don't go off like 81-ton guns, and become instantly quiescent.—FACIEBAT. The assertion was, perhaps, a little too sweeping; but, assuredly, as a rule, silicified wood is more recent than that mineralised in other ways—*e.g.*, the Craigleith fossil-trees, the ordinary carboniferous fossil vegetables, &c. Your suggestion that a man on a hill appears taller, from a spectator beneath him unconsciously setting him on the top of an imaginary column, is one the feasibility of which can only be determined by experiment.—SCORPIO. I do not fancy that the lecture to which you refer (excerpts from which appear in Bishop Colenso's work on the Pentateuch) was ever republished. The Association would hardly do it; and all its author's works with which I am familiar are monographs. I regret heartily that my inexorable rule about poetry compels me to exclude your very witty verses, but, if I let them in, just for the sake of giving readers a hearty laugh, I should have an avalanche of maundering rhymed nonsense in the course of three or four posts, accompanied by urgent requests for its insertion.—ST. LEONARD'S CLUB and GEORGE D. BROWN ask "Five of Clubs"—who is not at present in town—why, in the singular game of Whist recently played in America (p. 534, Vol. VI.), *Z* should take his partner's Queen in the first hand?—ARCHITECT. By all means use £. s. d. for yards, feet, and inches if you like. I am not concerned to urge that they had a long prior definite connotation.—J. MERCER sends an account of a surpassingly beautiful chromatic sunrise witnessed in Liverpool and its neighbourhood on the 12th ultimo. Has there been another Krakatoa eruption?—G. G. HURLINGHAM. Referred to the Messrs. Wyman & Sons.—S. HOPE. Your query is *very* much too vague. If you wish to study the face of the sky, furnish yourself with a really good 3-inch achromatic, and go systematically through the series of papers, "Nights with a Three-inch Telescope," which appear in our first four volumes. If you want to obtain a general view of astronomical science, buy Ball's "Elements of Astronomy," published in Longmans' "Text-books of Science."—R. F. H. is of opinion that the adipose tail of the Dûmba (a sheep peculiar to Afghanistan and the Cape) presents "a nut for philosophers," who are evolutionists, to crack. He also propounds the theory that whirlwinds have their origin in electrical discharges from the earth into the atmosphere, and that their subsequent course is largely influenced by terrestrial magnetism.—COMMENTATOR. Mr. Liddle (letter 1524, p. 471) will doubtless appreciate the recognition of the value of his evidence in favour of tea and coffee. I cannot insert poetry here, be it in the form of translation or otherwise. This rule is inexorable, and compelled me reluctantly to omit some very clever verses recently (*vide* reply to "Scorpio"). Your penultimate communication was left unacknowledged from its offensively patronising tone. I do not require your advice as to the method of conducting KNOWLEDGE—I do not really; and fail to recognise your right to speak *ex cathedrâ* as to what should be admitted into, and what should be excluded from, these columns.—W. L. CARPENTER. Received with thanks.—M.R.C.S. The odds that the guesser will be right in any single instance are obviously $\frac{1}{2}$. Now, by the familiar rule, if there be any number of independent events, and the probabilities of their happening be $\frac{1}{m}, \frac{1}{n}, \frac{1}{r}$, and so on respectively, the probability that they will all happen is $\frac{1}{m\,n\,r}$, &c. In your case, our hypothetical m, n, and r are all 2, so that the odds against a man being right (or wrong) *every* time are $\frac{1}{2^{14}}$ or $\frac{1}{16384}$.

Our Whist Column.

BY FIVE OF CLUBS.

THE following game is the one referred to in our last; it is in one sense artificial that the conditions described by Mr. Clay are led up to by play not described by him, but devised to bring about those conditions:—

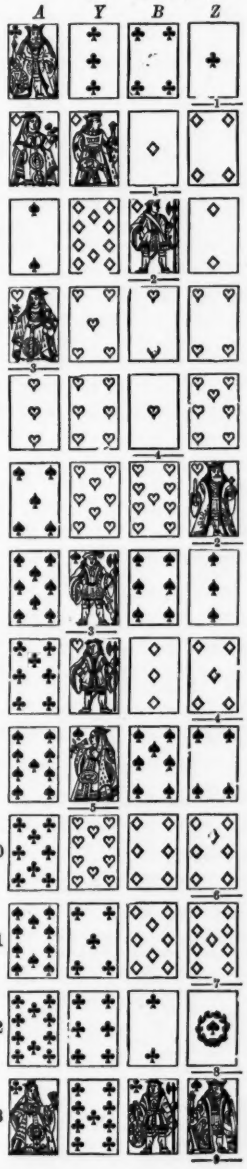
THE HANDS.

B { *D.* A, Kn, 8, 6, 3. / *S.* 7, 6. } C. Kn, 4, 2. / H. A, 9, 2.

Y { *D.* K, 10. / *S.* Q, Kn. / H. Kn, 10, 8, 6, 5. / C. 9, 6, 5, 3. }

{ 2, 4, 5, 7, 9. *D.* / 3, 4, K, A. S. / 4, 7, K. H. / A. C. } *Z*

A { *D.* Q. / *S.* 10, 9, 8, 5, 2. } C. K, Q, 10, 8, 7. / H. Q, 3.



THE PLAY.

Card underlined leads first.

1. *B* begins a signal, but he gets no chance to complete it.

2. *Z* leads his penultimate trump. *A* clearly has no more.

3. *B* should not have led back trumps, as *Z*'s lead and *A*'s weakness discounts *B*'s trump strength considerably. After trick 3 all the trumps are seen to lie between *B* and *Z*, *Z* having best, third, and fifth best; *B* having second, fourth, and sixth best. As *A-B* are two by honours, *Y-Z* must make three by tricks to save game. But this they cannot possibly do if *B* plays properly. For after the next trick,

5. *Y-Z* must make all the remaining tricks. Yet by sheer pluck on *Z*'s part, and bad play on *B*'s, *Y-Z* save and win the game.

6. *B* having but one trick to make, should here have led from his short suit. One ruff and all is over.

7. *Z* would be sure to lose if he led as usual from his Spade suit. The only chance is that *B*'s trumps may be led through twice, which, as neither *A* nor *Y* has a trump is impossible, if *B* steadily declines to be forced. He therefore leads his smallest Spade.

8. *B* yields to the force and one of his trumps goes. But even now *A-B*'s game is perfectly safe.

9. *Z* repeats his tactics. *B* ought now to know that *A* has the winning Club and the Spade Ten, so that as Spade Ace and King are with *Z*, *Y* can only have Clubs to lead after leading the winning Heart at trick 10. But

10. *B* again allows himself to be forced. And

11, 12, 13. The rest of the game plays itself. *Y-Z* make three by tricks and win, tricks counting before honours.

Our Chess Column.

By Mephisto.

AN INTERESTING VARIATION IN THE EVANS GAMBIT.

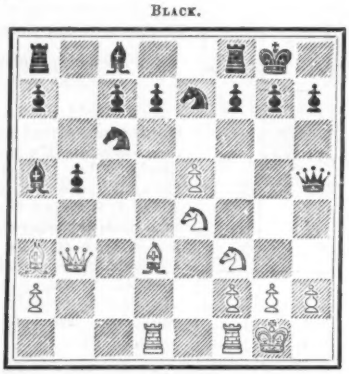
Compromised Defence.

A correspondent wrote, asking why we gave some specimen games in this defence in which White won, whereas we declared the play in favour of Black. Our answer is that we give specimen games not as theoretical proofs, but as practical illustrations of what a certain variation may possibly—but not necessarily—lead to.

These games have the further use of testing the soundness of theory. The more the games are at variance with a hitherto recognised line of play, the more the games deserve quoting, and if analysis proves the play sound, then the theory of the particular opening will have to be modified accordingly.

A case in point is contained in the following interesting variation, in which it is somewhat doubtful whether Black has really a good defence, *i.e.*, 1. P to K4, P to K4. 2. Kt to KB3, Kt to QB3. 3. B to B4, B to B4. 4. P to QKt4, B × P. 5. P to B3, B to R4. 6. P to Q4, P × P. 7. Castles, P × P. 8. Q to Kt3, Q to B3. 9. P to K5, Q to Kt3. 10. Kt × P, KKt to K2. 11. B to R3, Castles. 12. QR to Q sq., P to Kt4. 13. B to Q3, Q to R4. 14. Kt to K4:—

Black.



White.

We have recently played several games from this position, but have not been able to meet with any player who defended Black's game to our satisfaction. The best defence arose from Black continuing with

14.	P to Kt5.
15. B to Kt2	

More often than not Black lost. Black played now P to KR3, in order to avoid the threatened sacrifice of B × RP (ch) at the moment the Q reaches K3, but if

15.	P to KR3
16. P to KR3	

threatening Kt to Kt3; the Q could not retire to Kt3, on account of Kt to B6 (ch), therefore

16.	Kt to B4
17. Kt to Kt3	Kt × Kt
18. P × Kt	B to Kt3 (ch)
19. K to R2	P to Q3
20. Q to Q5	B to Q2

23. P to Kt4 and White won.

An interesting variation was tried here on Black's 20th move, when Black played Kt × P. 21. B × Kt, P × B. 22. Q × R, B × P. 23. Q × R (ch), K × Q. 24. P × B and White won.

Another line of play, recommended by Zukertort in his notes to his game with Hirshfeld, in the "Chess Monthly," was tried, *i.e.*,

14.	R to K sq.
15. Kt to Kt3	Q to Kt5
16. B to K4	P to Kt3
17. B × Kt on K2	R × B
18. P to KR3	Q to B5
19. B × Kt	P × B
20. R to Q4	Q to R3

21. Q to R3 and White won.

Then again in this variation Black attempted on his 16th move to play at that moment instead of P to Kt3, P to QKt5, which resulted not unfavourably, although by no means quite satisfactorily. On the other hand, we give another line of play, attempted by White, *i.e.*,

14.	R to K sq.
15. Kt to Kt3	Q to Kt5
16. P to R3	Q to QR5
17. B × P (ch)	K × B

18. Q × BP and White won.

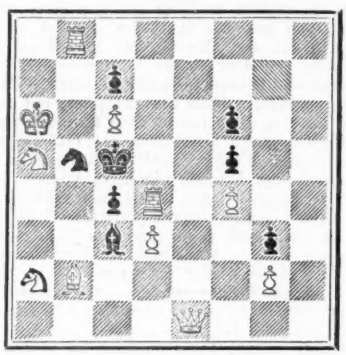
Finally we have to consider whether it is not after all a choice of the least evil for Black to play Q to K3, allowing the RP to be taken by the B, and moving in reply thereto K to R sq.

We shall be very pleased to receive and publish any noteworthy contribution by our readers to this opening.

SELECTED PROBLEM No. 145.

By W. R. Coe.

Black.



White.

White to play and mate in two moves.

SOLUTION.

Problem No. 143, p. 533.

1. P to Q6		B × Q
2. R to K5 (ch)		K × B
3. Kt to B6 mate		
1.	(*a*)	K to B5
2. B × P		P to Kt5
3. Q to Q5 mate		
2.	or	Kt to Kt5
3. P to K4 mate		
2.	or	Kt to K5
3. Q to B8 mate		

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Correct solutions have been received from W. Furnival, H. B. B., G. W., O. H. Labone.

Uncle John.—If 1. R to Q sq, Kt to Q2 and there is no mate.

G. W. wishes to find an opponent for a correspondence game.

O. H. Labone.—Received with thanks.

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